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#Internal

After many, many, suggestions on the reader arrangements, proposed quite tentatively at the R.N.M. As printing the year book is a major task, suggestions have been put forward at this meeting. For the sake of the library and compactness, the old method that will be too big for one room, it is intended to produce the "Summer and Winter" editions in one number. One journal will then contain the whole coverage of the Symposium rather than splitting it between two separate rooms. This will reduce the number of issues for that year so there will save the embarrassment of donating whole papers should go in the first and which the second year. Also readers will like to have all together. It is hoped that readers will be kind enough to produce their papers at good time for publication.

We had hoped to maintain the size cover in the next year, but the room made and an unexpected rise of 4', in printing costs has shown that it must not still be those comfortable. The use of a new block will be proposed, certainly much more use as the Printing room as that there is still a little bit in the old one.

Looking at the profit, the main cause of the loss of the last year is lack of advertisement. Next year we want to find customers without replacement. Readers can help by doing a little bit of personal lettering on the donations.

We are delighted to hear that Surgeon Captain Arthur Crocker has now regained full health and we wish him and his wife the very best of luck in his new appointment as Medical Officer at Ascension Island.

OSTEOGENESIS IMPERFECTA

(Syn. Lathraie's disease, Fragilis osseus, Osteopetritis)

A report of a case diagnosed in Diers

By Surgeon-Commander John Harrison, RN

Osteogenesis Imperfecta was first named by Wiedl, in 1846, though the post-natal condition was described in 1833 by Lathraie under the name *Megaphysa Chondroplastica*. The condition is characterized, though its exact character is difficult to establish. Evaluation of the incidence of the disease varies from 1: 10,000 (Pearse, 1931) to 1: 1,000 (Cox and Lawson, 1932). Much higher incidence rates have been claimed in smaller series (Stroma, 1942). It seems certain that some 50 more cases have been reported in World Literature by 1961 (Proke, Velebergh and Lohrer).

The condition is characterized by brittle bones which are also pathologically in a stage of osteoblastic activity resembling a scleroma of the organic matrix in which is deposited the mineral content of bone. The products break with a thin cortex and a sparse and fragile trabeculation in the cancellous bone (Fugh, 1954). The degree and extent of the diminished osteoblastic activity may well determine the type and extent of Osteogenesis Imperfecta present. The bone fracture may be most widespread and has been described in a fairly common case of osteoporosis where the adult collagen fibres in the cortex of the ribs, vertebrae, scapulae and ilia (Holl) have microscopical bone formation is not disturbed and frequent growth of bone is not limited. Any associated disorder is due to bowing and fracture of the affected bones. The blood chemistry is not specific. Serum calcium, inorganic Phosphorus and alkaline Phosphatase are usually normal (Murray, 1960). The serum Phosphatase may be raised if multiple fractures are present. It is of note that formation and resorption of collagen in such fractures is both early and rapid.

Several clinical, pathological and radiological descriptions of Osteogenesis Imperfecta have been made on the basis of age of onset and severity. It is true that the all reported variants of the more basic condition (Caffey, 1945) have demonstrated being the case of the first fracture due to the extent and severity of the variant types. It must be emphasized that the variation is only from the bones with multiple fractures in the children, adult with long thin bones which may fracture easily. Cases may be most mild or be so severe that the child dies in the neonatal period. The severity of the disease is obvious. The severe (bone marrow) form of Osteogenesis Imperfecta (Compston and Turle). The Compston form may be subdivided into severe and moderate. It is the most severe and few patients survive beyond adult life.

The inheritance of the disease is obvious. The severe (bone marrow) form of Osteogenesis Imperfecta (Compston) is said to be due to a recessive and Osteogenesis Imperfecta (Turle) form usually to a dominant gene. Consequently it is often accepted. The Turle form of the disease tends to occur in other members of the same family some of whom may have been affected through their bones may be normal. It is of note that Henry de Toulouse-Lautrec, almost certainly afflicted from the disease.

It is a clinical feature of the disease, along with the type, the frequency of the bone lesions, and their size, may be evidence of more advanced stages of the disease than the bone lesion. In the Tarda form pathological fractures due to osteoporosis, stress, and multiple trauma occur in childhood, adolescence or perhaps even in adult life. The lack of ligaments leads to a tendency to dislocation of joints. Bone sclerosis may be associated with the Tarda form and are usually absent in the infant, juvenile and infantile forms. Adults may develop osteodystrophy or show osteoporosis and therefore the disease at its adult form may be limited to hyperostotic joints, club deformities, a poor, de sloped, rather weak, and bones which appear slender and osteoporotic.

The radiological appearance of the disease though in the adult form of the Tarda type the changes may be grouped. Forthum (1911) described three types of Radiological changes associated with the pathological types described by Watson (1905).

1. A short long type with slender limbs and multiple osteoporotic fractures. This is the most common type and is rare.
2. A slender long bone type. The skeleton as a whole is osteoporotic. The long bones are slender and the cortex is thin.
3. Osteoporosis Imperfecta Cyano. An extremely rare type with honeycombed lesions.

Most cases of all forms show the changes in varying degree of type 2.

In Osteoporosis Imperfecta Cyano the radiological appearances of long slender bones with a thin cortex and poor trabecular pattern in the cancellous bone. The long bones may be bent and broken. The fractures show free callus formation. The skull is generally osteoporotic and may show marked changes of definite osteodystrophy. The facial bones may be poorly ossified.

In Osteoporosis Imperfecta Tarda—or the milder infantile form of the congenital type—the clinical features may be followed. The skull may show deformity of shape due to softening, and wormian bones. Bowed lower arms may be present.

Reports in the Radiological literature of Osteoporosis Imperfecta cyano type appear in where previously. Dunstan (1930) is credited with the first case. He defined a case in 1942. Aiken, Cohen and Verroo in 1954 and Callender in 1957. The present case shows most of the features of severe osteoporosis. Osteoporosis Imperfecta cyano type described. Not all the X ray changes described are shown in the X rays illustrated.

CASE REPORT

A 13 year old promiscuous white of an RAF officer was admitted to the Maternity Unit, R.N. Hospital, Haslem.

The mother had no history of collagen disease during gestation and had taken no drugs during 3 12 Hb 75. Group O Rhone negative. W.R. Negative. Normal chest X ray.

Both parents were healthy young adults. The mother's sister had had 2 hydroxyphosphate infusions—one died at 2 years and the second one was alive at 1951 at the time of the present birth. The father had a markedly deformed system (severe osteodystrophy) and a case with pronounced osteoporosis.

History, examination and investigations

There was a 10-day interval of desquamation and *Leishmaniasis* was diagnosed in RWH Hospital, Malawi.



Fig. 1. Newborn infant.

Weight, 2.60 kg; height, 48 cm; length, 36 cm; weight, 3.6 kg.

No evidence of desquamation.

Partial skull appeared normal. There were multiple, apparently united rib fractures. There was a fracture of one femur; the remaining femoral bones were apparently normal. The appearances were suggestive of *Chlamydia trachomatis* congenita with characteristic pathological features: the rib fractures suggesting sepsis. There appeared of normal length and was apparently conjugate.

The second stage of labour lasted 35-40 min and apparently was performed.

After delivery, on 4 Dec 4, 1981, the sick infant's initial condition was poor. Spontaneous respiration was established after 4-5 min. The infant's head was soft of 14° circumference and general hypotonia was present. The eyes were closed but the sclerae appeared normal. Bilateral oligo retinopathy was present.

The weight was 4.0 kg and of course pale. Qualitative of the blood count appeared poor. The pelvis and umbilicus appeared normal. There was a fracture of the left clavicle. The clavicles were not thickened. The rib fractures were apparently united with some deformity of the thorax. There was a fracture of the neck of the left humerus without callus formation. There were double fractures of both femora with callus formation. The femora appeared thickened and somewhat rough with a thin coat. The epiphyses appeared normal. There was a mid-shaft fracture without callus of the

COMPOUND-COMPOSITE DENTONE AND UNERUPTED CANINE TOOTH ASSOCIATED WITH A MAXILLARY CANINE RETAINED FROM THE DECIDUOUS DENTITION

By Margaret Lundquist (D) and E. Jones, D.D.

Case Report

The patient is a 27-year-old man presented to his dental office complaining of a loose tooth.

On examination there was a grossly upper right canine extending from the gingiva one centimeter and half up on the buccal sulcus above his tooth. It was possible to palpate an irregular bony hard surface about 1 cm. in diameter. In addition there was a hard pseudo swelling under the displaced lower palmar to the right of the median of the palate.



Fig. 1. Upper right canine tooth, loose, and bony hard surface.

A radiograph was taken of the patient, and an unerupted canine was seen in right canine and a pseudo swelling of the alveolar bone above the unerupted deciduous canine suggested a compound-composite dentone. The case was referred for treatment.

At operation (palmar and buccal) a large buccal flap was raised over the buccal swelling and similar bone removed to expose the area. The enlarged mass

removed of 3 separate dentules underlying the gingiva. At surgery and composite odontoma. The dentulous crown was removed, and the period incisor crown reflected as far back as the lingual sulcus. Removal of palatal bone exposed the buccal crown which was elevated, and the flaps were replaced and sutured. Recovery was unremarkable and the patient was discharged from hospital 3 days after operation.

Pathophysiology of Compound Composite Odontoma

These odontomas consist of a number of very denticle lying close together in the anterior incisor and occasionally at the end of a cyst. They may vary in structure from an aggregation of denticle dentules resembling crown teeth in a confused manner of dental dental tissues. In the connective tissue epithelial debris around dentules and crown teeth may be found. The teeth may be mature.



Fig. 3. Coronal, Composite, and Compound Denture of Denture of Dental crown tooth.

Antiology and History of Odontoma

Odontomas are developmental anomalies of the dental formative tissues regarded as outside the range of normal variation. They are malformations of unknown origin possibly the result of some kind of embryological accident, though in a few cases there may be evidence of hereditary predisposition.

These tumors may be classified as hard or soft.

Soft Odontomas—These are generally made up of cells that form enamel, dentine and sometimes where calcification has failed to take place. When enamel and dentine of enamel epithelium are found in the mesenchymal matrix, it is difficult to distinguish them in nature from those found in odontomas.

Hard Odontomas—These are generally made up of mature dental tissues. They include complex compound odontomas, compound composite odontomas, inverted odontomas, granulated teeth, enamel nodules and enameloma.

Summary

The treatment of a case of compound composite odontoma and an inverted crown tooth in the maxilla is described. The aetiology and nature of odontoma is briefly discussed.

Articles

HERPES SIMPLEX INFECTIONS OF THE CORNEA AND THEIR MANAGEMENT

by Surgeon Captain D. P. Gurd, RN, Surgeon Commander H. E. A. Tabor, RN, and
Surgeon Lieutenant Commander A. J. Bagwell, RN

The purpose of this contribution is to discuss a very common affliction of the eye which can cause great discomfort and permanent visual disability should the diagnosis be delayed or the treatment unsuited.

The virus of herpes simplex is ever present in many organisms whether in a dormant or active state. After a primary infection the virus tends to remain latent in the affected tissues permanently in the mouth, nose, genital area, genitalia in males. Confined to these locations the infection is relatively unimportant and active lesions such as the cold blisters¹ of the lips or skin are healed readily, but should the eye become involved by contact with discharge from these lesions the results are very disabling and often serious. For example, a mother with herpes of the lips may infect the eyes of her children through suckling them, and should be warned of this danger. It often occurs in young persons who go abroad for the first time (Dedgson, Gurd, 1954).

Signs and Symptoms of Corneal Involvement

The patient usually complains of a stinging sensation in the eye, lachrymation, and inability to withstand the light. The eye may feel 'rough' and the vision may be impaired.

The examination of the cornea may be assisted apart from a slightly everted watertight eye with a light photophores. Without special examination such a patient may be examined for the presence of a foreign body, the eye instilled with an anesthetic applied. The normal cornea, however, presents a highly regular reflecting surface and if the patient is instructed while he fixates, within the reflection of the window on the internal surface can be studied with special reference to the definition of the vertical and horizontal members of the window frame. A slight distortion of these is a certain indication of irregularity of the corneal surface (Figures 1 (a) and (b)). The great advantage of this method and delicate observation is that it requires no application of any fluid.

In the earliest stages of infection by the virus herpes simplex, the irregularity of the corneal surface is caused by small vesicles. These rise to the front and when they do so they leave shallow depressions of the epithelial continuity. These have a very characteristic 'Christmas tree' like appearance when viewed by fluorescence or rose bengal (Figure 2).

Prognosis

The condition is serious in that it causes considerable corneal distortion which often seems to be disproportionately profound. Scars are liable to adhere thus. A high vitamin C intake is said to be helpful and can do no harm. In accordance with such latest practice a search for food sources is made.

days and the maximum ten days. All dendritic spines were first simple and had no previous treatment except saline. Nos. 1 and 5, which had been on steroid drops for two weeks before being seen.

Patient No 1. Duration—two weeks

Previous treatment—steroid drops three times daily.

Site of ulcer—area central above and via peripheral vision

one situated centrally and another of equal size situated in the upper temporal quadrant

Treatment—Kercol in the usual dose of these days without reduction or change in the instilling time

The ulcer was both superficial and healed within 48 hours

Initial V.A. 4/5 final V.A. 4/5

Complications—nil

Patient No 2. Duration—one day

Site of ulcer—the lower temporal quadrant left eye

Treated with Kercol in the usual dose for five days in the usual dose

The ulcer was completely healed by the fourth day

Initial V.A. 4/5 final V.A. 4/5

Complications—retrobulbaritis, was treated with Atropine and topical steroids and cleared within ten days.

Patient No 3. Duration—two days

Site of ulcer—in the nasal area of the right eye

Treated with Kercol in the usual dose for five days by which time the symptoms cleared and three small persistent dendritic spines had developed. Kercol was stopped on the fifth day and the eye was sealed

The ulcers had healed by the second day after cessation

Initial V.A. 4/12 final V.A. 4/8 post

Patient No 4. Duration—three days

Site—lower nasal quadrant right eye

Treated with Kercol drops at the usual dosage for nine days

No changes were noted in the size or in the extent or depth of dendritic ulcer and the ulcer was reduced on the tenth day and healed with out further complications within three days

Initial V.A. 4/8 final V.A. 4/8

Patient No 5. Duration—three days

Site—nasal area right eye

Treatment—Kercol in the usual dose for two days by which time the ulcer had healed without complications

Initial V.A. 4/8 final V.A. 4/8

- Patient No. 6:** Duration—seven days
 Site—double above lower half right cornea
 Treatment—Kercol as the usual dosage for four days.
 The ulcer healed without complications by the end of the second day.
 Initial V.A. 6/12, final V.A. 6/6
 A dendritic ulcer developed in the left eye on days four
 Site—nasal area
 Treatment—Kercol as the usual dosage for four days
 The ulcer healed without complications at that time
 Initial V.A. 6/6 final V.A. 6/12. On review 11 months later for
 A telephone occurred 11 months later with normal involvement which
 responded in 7 days to 1 D.U. therapy
- Patient No. 7:** Duration—3 days
 Site—nasal area right eye
 Treatment—Kercol given as the usual dosage. No improvement after
 four days and the ulcer had extended. The ulcer was washed on 90
 and a pen on 7th day and healed without complications
 Initial V.A. 6/12, final V.A. 6/6 post
- Patient No. 8:** Duration—4 days
 Site—near limbus at 9 o'clock
 Treatment—Colistin on 7th day without effect. Kercol started 11th
 day. Ulcer healed after four days/treatment
 Initial V.A. 6/5 final V.A. 6/4
 No complications.
- Patient No. 9:** Duration—13 days. Punctal plug
 Previous treatment—Atropine drops and ointment
 Site of ulcer—Two areas of dendritic ulceration involving the nasal
 half of the cornea.
 Treatment—Kercol by the usual routine hourly by day and two
 hourly by night.
 The ulcer healed completely in 4 days. The contact lens was removed
 to be much improved but visual acuity was 6/6

It will be noted from these short summaries that 1 D.U. was associated with a rapid cure in 8 eyes while in 4 it had no apparent effect. In the treatment cases the condition was treated by the application of penicillin ointment in 5 patients and by other two responded to the direct application of an alcoholic solution of iodine and potassium iodide (iodine 7 per cent, potassium iodide 5 per cent, alcohol in 100 per cent). A notable observation which is in keeping with those of other observers (Derdikson, 1962; Derdikson and Jernstrom Evans, 1965) is that 1 D.U. if it is going to control the condition does so within 1 week. As a rule the beneficial effects are comparable to the 3rd or 4th day of treatment. A useful second line of attack is to use 20 per cent zinc solution in distilled water dropping the solution on to the cornea and washing off after 4 or 5 minutes contact (Bliss, 1966).

Summary

- (1) Herpes simplex Keratitis, a very common ocular condition, has been discussed and details of its aetio. effected by repeat dendritic central vision have been given.
- (2) The effect of treatment by I.D.U. drops has been described. This material has been valuable in 4 out of 13 of the eyes affected. It appears that its benefit when they occur are rapidly obvious. One eye which failed to show benefit from instillation responded to Karastol (4.25%). Four eyes unaffected by Karastol responded to combination by corbolic acid or by atrophic instillation of saline.
- (3) There was one instance of relapse three months after apparent cure. This patient also showed herpetic involvement which is uncommon although only one eye participated in the relapse.
- (4) The virus is small and is strictly based on morphological dendritic Keratitis as supported by virus culture. The results herewith are in keeping with those of other observers.

Conclusions

Dendritic ulcer is a recurrent condition, which eye seriously impact the vision of an affected eye with great regularity if undisturbed or untreated. In dendritic cases, simple instillation of the virus by 2 per cent. herpetic solution or 1 per cent. rose bengal will establish the diagnosis. I.D.U. drops hourly by day and two hourly by night, are a workable first treatment and should be persisted on until epithelial fully becomes available. On no account should over-extended preparations be used in these materials the properties of the virus. The pupil should be kept dilated and the eye covered by a pad between treatments. The day should contain a high vitamin C content. Herpetic vaccinations carried out every 4 or 5 days, for three months may help or lessen the severity of an attack by herpes simplex. Should I.D.U. prove antiseptical 25 per cent. virus solution, as dendritic ulcer may be dropped on the cornea, allowed to soak for five minutes and then washed away.

This short article is intended to help the medical officer who is not an ophthalmologist with the management of a common and interesting condition.

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A CASE OF MASS POISONING WITH MERCURY VAPOUR ON BOARD H.M.S. TRIUMPH AT CADIZ, 1894*

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It is stated in a private letter from Cadiz that when the first barometer observations were taken, picked up near 300 boxes of gunlocks which, for the purpose of being taken care of, were stored in the store-rooms and the hold, but the boat having raised the boxes to deck, several men, of the number that ran through the ship, which had such an effect on the crew that 300 of them were obliged to be drilled immediately, instead of when a reduced number were

They report, posted in the *Naval Chronicle*, was the first to be received in English concerning the air in a cabin that held the ship's company, in H.M.S. *Triumph* at April 1894. The lesions were not so common as the report anticipated but the incident caused considerable suffering and the ship had to be withdrawn from Cadiz at a time when the port was being besieged by the French army.

The *Triumph* a 74 gun line-of-battle ship, launched at Woolwich in 1784, had performed valiant service during one of the greatest periods in British naval history. She fought at Camperdown in 1797 and under Admiral Cuthbert when he captured the combined fleet, off Finiserra in 1805. In 1778 Captain Saunderson brought on board to her captain his daughter. The twelve year old Harriet Nelson. Thirty five years later, in 1813, the ship was commanded by Thomas Mordaunt Hardy. Nelson's own flag captain at Trafalgar.

Captain Hardy was succeeded by Samuel Hood, Lucas and under his command on Christmas Day 1828 the *Triumph* sailed from Cadiz. There were on board 387 men, 21 short of the normal complement of 408. Ten months later on 2 and 3 March, a violent storm made havoc among the shipping in the harbour. An English frigate, three Spanish battleships and several merchantmen were wrecked, some of them on the shores commanded by the enemy frigates. After the storm, boats from the *Triumph* went to the aid of the wrecked ships. On 6 March they rescued men from a merchantman, the *Maraca*, on 8 March from the *San Ramon*, a Spanish military frigate and on 15 March from a Portuguese battleship, the *Vasco Ponce*. In the course of this voyage the officers and men from the *Triumph* salvaged from one of the battleships a large cargo of mercury metal which was lost, and, before the return for French Biscaya, where it was to be used to extract silver from the ore.¹

The mercury was stored in as leather bags, each battleship fifty pounds and the bags were packed in barrels which were stacked in boxes. The salvaged cargo, made of a material with no water, was stored in the after hold, on the adjoining deck, stowage and below stowage on the cargo, the lowest deck of the ship, situated between the hold and the lower gun deck. All the copper masts used for the masts of the metal were badly corroded and before the waterline. Most of the mercury was kept above the *Triumph* Range was loaded into the ship's flasks which arrived in Cadiz on 14 March.

* Reported first, in *Naval Chronicle*, July 1894 with the first mention of the illness and fatalities.

The weather was hot, and under these conditions some of the men suffered from heat and a large quantity of the liquid metal overflowed and covered some escaped and flowed over the wing deck and fuselage penetrating injuries and burns. Yarnum was, on the metal and the Venturiing Officer at Columbus was later to condemn 7 500 pounds of liquid for having quantities stored with it. A similar accident occurred on the *Phages* where the escaped mercury flowed over the field and among stored cables and rudders.

Within three weeks of the accident cases of mercury poisoning appeared among the crew of the *Triumph*. The commonest symptom was psychosis, an extreme sensation of sadness, and that was accompanied, on many cases, by alterations of the mouth, parotid paralysis, and forced compliance. The first to be affected were the carpenter and gunner whose cabins on the wing were separated from the main rooms by wooden partitions so that when the mercury containers broke the metal flowed through cracks into their cabins. The degree of poisoning experienced by the women and nurses depended upon the position of their living quarters. The men who lived and slept under the life line escaped with a slight effacement of the gums. Those who inhabited the main and upper decks were also only lightly affected. The worst were the seamen who lived on the lower deck and sleep. Significantly the least affected among the seamen of their class were the stowaways whose decks kept them on the upper decks for long periods and often employed them away from the ship. Furthermore their small overcrowded mess was ventilated by windows although the cover was not very effective when the ship was taking to sea.¹

Others were not so fortunate. Those who lived on the lower deck, badly ventilated, damp and foul with the first smell of urine and staled provisions, were exposed for long periods to a high concentration of mercury vapour. The temperature below decks might well have been about 29°C (84°F) and at this temperature the concentration of mercury at saturation point is 14 mg. per cubic metre of air, which is 140 times the maximum allowable concentration (2 mg. per cubic metre).² The plight of the most severely affected was painful. Petty Officers were among the worst sufferers and their heads and temples swelled to a most alarming degree. Two seamen, who subsequently died, lost their teeth and suffered from gangrene of the tongue and cheeks. A woman confined to bed on the wing, with a broken leg, lost her teeth and suffered from 'inflammations of the upper and lower jaws'. These descriptions indicate that these people were in an advanced stage of mercury poisoning. The toxicologist Robert Chesterton described this condition as one of profuse salivation, the face swells as it is closed the eyes and almost fills up the space between jaw and forehead, the tongue is so swollen it threatens to suffocate the patient, the inside of the mouth ulcerates because gangrenous and sometimes the gangrene extends over the face.³

Other forms of life on the ship were all affected. Sheep, pigs, goats, poultry, cats, a dog, a monkey, man, mice and even cockroaches were all destroyed. And there was further evidence of the presence of the mercury was its effect on the metal fittings on the ship copper bolts, brass rods, stowage bins, gold watches and money became covered within a week of mercury.

Many of the crew of the *Triumph* had been forced into the service of the navy, the majority were living under unhealthy conditions and all were subjected to a harsh

despatch. Nine days were required for the maximum effects of mercury vapour and the resulting condition may have brought about a rapid decline in morale. The confidence in the efficacy of mercury poisoning. The patient becomes restless and nervous, he loses self-confidence, feels a delirious or angry disposition and is unable to judge distances. I have never noticed such wild behaviour on board the *Triumph* as a fighting ship was seriously engaged – a critical situation at a time when the ship was in the presence of the enemy, exposed to the hazards of war and forced to meet its most formidable foe of ships and shells.

The late daily entries in a ship's log rarely reflect the human drama and drama aboard and the events in the *Triumph* during the time period set for description. On 16 April, after describing the weather and persistence of fever attacks on the log made, I noted that the *Quadrifidus* on shore 'is observed as necessary'. This reference to the arrival of the main medical cargo is the first and only reference to the mercury. It was made at a time when the dehydrated vapour coming off the metal was having a frightening effect on the health and morale of a large part of the crew. In mid-April about two hundred men were showing symptoms of mercury poisoning – nearly a third of the total complement of the ship.

On 22 April the sick were sent to hospital ships, and shortly after Rear-Admiral Pickens, Commander of the hospital, ordered four fire engines to make an inspection of the *Triumph*. Their report caused him to order Captain Lambert to take the ship to Gibraltar, there to discharge her sick to hospital and clean the ship of mercury. On arrival at Gibraltar on 8 May the sick were sent to the Naval Hospital. There were fifty-five cases of poisoning, mostly sailors and seamen, but including the British surgeon and surgeon's mate. Most of these men were again sent to seven or seven days in hospital before being discharged back to their ship. Four of them, however, remained in shore for eight weeks.

There is no record of the treatment given in the hospital. On board the *Triumph* patients had been given large doses of sulphur, but its side effect was to cause a severe constipation, and to increase the sufferings of the men. Sulphur is not listed among the many supposed remedies for mercury poisoning and it must be assumed it was given as a mild laxative and in a remedy for the diarrhoea.¹ There would have been no doubt as the hospital was the centre of the population. The first report to reach England was printed under the heading 'poisonous effects of the effects of quadrifidus'.² Naval surgeons were faced at work the effects of mercury because they had long been used in the treatment of venereal disease and they would know that side effect appeared when the substance was withheld. It is, therefore, reasonable to assume that treatment in the naval hospital was no more than palliative.

On 30 May two men were admitted to hospital suffering from delirium. One of them was the Yeoman of the Powder Room, which was situated next to the hold where the mercury was stored, and it is therefore possible that there were cases of self-harm. Both men recovered after a fortnight's absence. Three other men were admitted with phlegm and pus, and of these, two died. There was also, in addition to the mercury poisoning, an outbreak of diphtheria. Eight cases were sent to hospital on 7 May and five more by 7 June. This was a common condition in the navy at this time and is variously described as 'ulceration', 'pitted' or 'corrosion' about the lower extremities

near the stern affected in the days when small measles struck here or vessels to, and returned and passengers. The crews were described as having the character of the most sane of seafaring men but they took place in circumstances in which there was no other symptom of sanity nor did they yield to logical proof.¹⁰ Episodes of illness had occurred on board the *Triangle* on previous occasions: outbreaks are recorded in the West Indies in 1781 and off the coast of Ireland in 1786 when eighty-four men were on the sick list. In Cuba in 1810 there were men who had suffered in previous outbreaks but it is recorded that their illness 'which had long been completely healed' resumed soon on reentry of the ship to port again, and went just as a plague did on reentry.¹¹

When the sick were taken the remainder of the crew were sent to work, stopping and cleaning the ship. All stores were removed and the hold washed down. As much of the ship as possible was cleaned even down to removing the shingle and iron ballast. In Lisbon, in the very same week, a similar operation began on board HMS *Porpoise*. The ship had left Cuba on 28 March, arriving in Lisbon on 5 April. Shortly after that the sailed for Oporto returning to Lisbon on 7 May. The only two women and fourteen men, who made up her company, had suffered less than the men on the *Triangle*. This was doubtless because of the more open structure of the small ship and because her periods of sea would allow ventilation and keep her crew, kept on the upper deck. It is reported that many of the men were affected but these conditions did not appear to have been serious. This is confirmed by the fact that within the highest degree recorded for this period a fever. On the way to Oporto the ship's carpenter was transferred to a transport, and it is possible he was a victim of the measles because his duties would often take him to the lower regions of the ship where the vapour had concentrated. In the effort to rid the ship of mercury the board rooms was used and when unworked stores in the hold reached out and the hulls covered. Finally the ship was hauled alongside the pier at low tide, a hole drawn in her bottom and, scuttled to allow the tide to come in and clean her. The operation was apparently successful and after the hole was stopped the ship resumed her duties without further mishap.

The *Triangle* was not so fortunate simply because it had proved impossible to remove all the mercury from the many nooks of the large vessel. Even so the crew retained the ballast and supplies there were fresh cases of sickness and by the time the re-ordered *Cinder* on 7 June new cases were being reported each day, some of them related again from the earlier outbreak. A week later the ship was withdrawn from the squadron and on 17 June she weighed anchor and sailed on her way to England.

The voyage took three weeks, during which time fifty sickness and deaths were not in remote transports. Precautions were taken to protect the health of the remainder of the company. Participating materials were burned in the hold under the supervision of one officer.¹² The object of this precaution, as it is made clear by one effect would be to raise the temperature and so increase the concentration of mercury vapour. For sanitary measures were taken to remove the crew from the vapour and improve ventilation below decks. The men were kept constantly on the upper deck during the day and food was allowed to sleep on the upper deck. When the weather permitted the lower gun-ports were opened and windows were in operation throughout the voyage. These precautions were apparently successful because when the ship reached Plymouth it

On 3 July one crew of physician was on board. There were however, no epidemics of infectious illness and thirty four cases were sent ashore to the Royal Naval Hospital, Liverpool, nine were still in hospital in September and the last was not discharged until November.¹⁰

The last days of the commensal were spent in the dairy tank of camp yard the ship of parasites, sailors and stores. On 18 August Captain James went on to a Royal Arsenal of the fleet, closed the log of the *Triumph*, the crew having already been discharged to a graced ship, the *Scholar del Mundo*. Little more is heard of the *Triumph* the vessel as a quarantine ship for a time and was eventually broken up in 1878.

In the year 1878 poisoning with mercury was a well-known phenomenon. The use of soluble mercurials and mercury ointment in the treatment of syphilis had foundered doctors with salivations and other symptoms that are a consequence of the absorption of mercury. Poisoning with mercury ointment had long been recognized as an industrial hazard and many among miners, pickers and miners' wives had been reported by the beginning of the eighteenth century.¹¹ Accidental poisoning with vapour of, however, a more occurrence would though indeed well cases occur from time to time.¹² The incident on board the *Triumph* stands alone in the history of toxicology.

NOTES AND REFERENCES

1. The vessel then the quarantine, *Triumph*, was sent to Liverpool and again broke of the Naval Medical Service Office, June 13 1877, June 17 1877 and the log of the *Triumph*, June 13 1877. The two logs make no reference to the subject of the mercury. Details of the poisoning are given in the ship's correspondence reports. 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EAR PLUGS—OR—DAMAGED HEARING *

By Surgeon Lieutenant-Commander R. E. A. Crites, USN

In several instances, some deafness has been a recognized byproduct of various occupations, notably in the Service. More attention is given to it nowadays because the noises are greater, their effects are more severe, we know more about the dangers which may arise and because different means of protection (other than ear plugs or by ear muffs, have become available.

A noise does not have to be unbearably or painfully loud in order to damage hearing. Within 20 feet of any rifle (M1, K or M14) or a flash gun, the noise is hazardous to hearing. Larger weapons, artillery and so on, guns including submachine guns and flash guns, need greater distances for noise safety. Noise of helicopters (both inside and outside the aircraft), unarmored fighting vehicles and personnel carriers, are also hazards.

Noise causes both temporary and permanent hearing losses. The temporary effect is a dullness of hearing, with or without a ringing sensation in the ears, which is often noticeable during and immediately after noise exposure. Absence of these symptoms does not mean that the noise has not had an effect, though. Its such temporary effect there is probably a permanent component. There is often no pain, but occasionally it may be quite large, either way. With such occasional exposures, the permanent loss, nevertheless, slowly changes and usually not noticed for a long while, partly because they are so gradual and partly because the loss tends to be affected in the opposite treatment of other people's voices. Understanding of what people say is a limited matter but this is not nearly so noticeable to the hearer.

In occupational noise, the temporary losses are important in themselves and should be prevented so far as possible (that is, no practice shooting or test firing as directed) even during the preceding day or two. On the other hand, during training at home and at home abroad, the object of ear protection is to prevent the accumulation of permanent hearing losses.

Apart from possible effects on man's hearing while still young, there is another more ghastly consideration which has to be taken into account. That is the effect of aging. Loss of hearing with advancing years is inevitable and in the ordinary way, however, noticeable by late middle age. Even small degrees of non-remediated hearing loss, then noticeable as described, will eventually be added to age deafness. The result is that instead of a slight disability in old the man's hearing becomes impaired as in earlier age and eventually becomes a much more serious disability than it would otherwise be or have.

Most important of the harmful effects of noise on hearing, as far as Royal Marines are concerned, is that which is probably less noticed. A balance of non-remediated hearing loss is that is that it only affects sounds of high pitch, without causing any reduction in hearing for speech. In ordinary life that effect may be recognized as in

*The hearing test of an article submitted by the Editor and I heard it is a splendid background to all the important things going on and protection in Royal Marine personnel.



Fig. 1
Headset, No. 100
Type No. 100
1. Headset, No. 100
Type No. 100
2. Headset, No. 100
Type No. 100

enables us hear such things as a radio set, a telephone bell, loud calls or the whistle of a submarine. These are, however, not the only sounds to be affected. In 1944 Murray and I did what had been much concerned with Australian military problems during World War II, suggested that even early stages of noise induced hearing loss would affect a man's hearing for such sounds as nothing better, stepping, heavy machinery, footsteps. The danger of failure to hear these sounds by men on sentry duty or guard, or saving an ambush or defense. Such failure could result from a previously acquired (permanent) hearing loss, but it could also be caused or made worse by unacquired temporary hearing loss, acquired during weapons practice or forward service. These temporary losses could only be prevented by use of ear protection.

Of the ear protectors available to Royal Marines, the standard model (V 3112) ear plug is very effective and, if fitted sufficiently tightly, will keep enough noise out of the ear to give it almost complete protection from gunfire noise. Since it fits and material known to plug down, will be used (see Fig. 1) (B. M.) 100 (B) as a reserve source of ear protection for use when the standard plugs are for any reason not available. Culture would, when dry, is very efficient but it would be used with petroleum jelly and carbide packed, so the ear is kept moist all day, as the kind, not in



Fig. 2
Earplugs, No. 100
Type No. 100
1. Earplugs, No. 100
Type No. 100
2. Earplugs, No. 100
Type No. 100

of sound with your fingers, but observed when the handset communication is in the system. VIBR and glass shows our plugs quickly using the physical cue. Consider it is the ear stuff used in the Royal Navy for hand communication.

There is one other problem, not place of correction, but in communication difficulties. In fact, when you can usually hear the speaker as well as in better when wearing our plugs as you can without them, but in the quiet because when they do make hearing others is not more difficult. Occasionally this can be dangerous, for instance during field firing or waste confusion when communication is difficult anyway. Most use of our plugs would then be practical, but only in an occasional



Fig. 3. Cross-section of (a) glass fibre plug, (b) glass fibre plug, (c) glass fibre plug, (d) glass fibre plug.

exception to the rule, and not in contact practice during field firing. An attempt is being made to overcome this problem via a post research programme between IIR Medical School and Southampton University is making progress in an attempt to develop a new plug that will cause less speech interference but will still be sufficiently effective against noise, of guns and small arms.

The only practical way to prevent damage to hearing from weapons noise is to protect the ears. It is true that some people are much less susceptible to the effects of noise than the majority, whilst others are much more susceptible. It is however impossible to tell reliably who is likely to be affected and who is not. Therefore, groups for the comparatively rare occasions of actual battle or of unusually difficult field duty conditions, the rule must be that whenever there is a noise hazard everyone must wear ear protection.

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PRESSURE TESTS ON SUBMARINERS DIVERS AND HOSPITAL PERSONNEL

By P. Færevik

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The necessary qualification allowing a person to undertake training for work and by pressure environments is the ability of the subject to equalize pressure in the middle ear and paranasal sinuses with the external environment. Thus it is necessary to test the applicants with respect to this ability. By such a person's test gear not be contaminated of training a certain fraction is expected and this question will be the subject of this paper.

In a report published by the Ad Hoc Committee on Hyperbaric Oxygenation in 1945 it is claimed that "approximately 3%" of the general population cannot successfully equalize pressure. However, this oft-quoted statement lacks support. A. B. Schibye (1946) stated "that out of 2000 qualified submarine personnel (18-35", were unable to equalize pressure in more of 3 or more points per square inch, and suggested it to be about 50", among the entire population.

The discrepancy between these statements indicates that further investigations are required. The purpose of this study was to analyze the equalization rates in three population groups subjected to pressure tests and to determine the frequency of pressure complications (barotitis media, barotitis sinus and barotitis mastoid) caused by high pressure exposure.

MATERIALS AND METHODS

The series consists of 1109 persons subjected to pressure tests in the Diving School of the Royal Danish Navy. All prospective pressure tests on persons who had previously passed such tests are included from the series.

The series is divided into three groups: I Submarine personnel II Divers (apart from III Hospital personnel).

I Submarine personnel This group consists of persons who during their military service were selected at random for submarine service. Barotological results of these individuals (ophthalmological and otoneurological examinations etc.) the only requirements to be fulfilled before the pressure test is satisfactory. A total of 1109 persons whose ages ranged between 18 and 36 years, were tested.

II Divers (apart from III Hospital personnel) are military or civilian persons applying for training as divers above 30", are included. The military system is represented mostly from the Danish Navy, the rest from the Air Force and the Army. Presumably all applicants have been subjected to a medical examination similar to that of group I and those who pass this examination are then subjected to the pressure test. A total of 606 persons, between the ages of 18 and 36 years, were tested. There were no women in groups I and II.

III Hospital personnel The total number of persons tested was 134 including 12 females (between the ages of 20 and 42 years, the remainder were 112) male divers aged from 26 to 48 years.

Of these 124 persons, 47 nurses and 48 doctors came from first hospitals in Copenhagen and were considered as so far as the only requirements before the test was a normal chest radiograph and a history of no acute or chronic pulmonary pathological diseases. These 95 persons were tested during a clinical trial with hyperbaric oxygen therapy. The rest were 12 doctors subjected to a voluntary test combined with their education in naval medicine. Many of these 124 persons were included because they were specially interested in hyperbaric oxygen therapy or high pressure physiology.

The pressure test consisted of a simulated dive to a certain depth in a decompression chamber. Only a few persons were tested per day, so that the individual exert and motivation were optimal. Most frequently one or two test subjects were accompanied in the chamber by at least one attendant, and the maximal number of persons in the chamber was six.

During test period (220 persons) the pressure applied was 4 atmosphere absolute (at. abs.) but the majority of groups I and II (1117 persons) were tested up to 6 at. abs. Of the 72 doctors in group II, only 74 were examined at 6 at. abs. and the rest (32) at 4 at. abs. The last 52 (45 doctors and 13 nurses) were subjected to a pressure of 3 at. abs., since this was the maximum level used in the hyperbaric oxygen therapy in which they were involved.

Before the pressure test was undertaken, the applicants were carefully instructed in the technique of pressure equilibration. The technique was a modified Valsalva manoeuvre (Valsalva, 1789). As Valsalva pointed out, the pressure in the nasopharynx is raised above that of the ambient atmosphere by pinching the nose and closing the mouth during a forcible expiration. The modification consists in evaluation of Valsalva's thinking that the elastic airways are allowed to distend, which is a reliable creation of a nasopharyngeal pressure above the ambient. Compared with the Valsalva manoeuvre involving closed or a dynamic and loss of pressure equilibration and progressively less efficient as the ratio/mass-pressure difference rises (Freeman, 1957). All persons who were unable to perform the Valsalva manoeuvre on test were before entering the tank were treated with ephedrine solution (1%). Only persons who could perform the modified Valsalva manoeuvre outside the tank were permitted to enter the tank. At any step of the exposure to pressure, ephedrine solution was administered, if necessary. The compressed air was produced in a building adjacent to the high-pressure test, stored in a water chamber for 24 to 30 hours, then transferred to another water chamber, passed through a water gel filter and a final filter with copper powder. The rate of compression varied between 0.15 and 2.0 mm/min (mean 0.5 to 0.6 mm/min) according to the needs of the subject. The maximum exposure during the pressure test was the subjective indication of pain in the middle ear or peripheral nervous system (even after repeated instructions, application of decompression and manual attempts at chronic compensation trials). The development of such pain at the expense of a sensory or other psychological findings, but severe enough to hinder the attainment of the required pressure in the concept of equilibration difficulties used in the study. The definition of barotrauma was here demands the presence of one or more objective signs.

RESULTS

The results cover an eight year period, evenly distributed over the seasons, no

significant variation in the amount of anesthetic oxygen was supplied to it during this period.

The results of the tests are shown in Table 1. Of the total 1850 persons, 175 were exposed to 4.0–8.7%. There seems to be no difference between the results of the tests at 4 and 6 or 8% oxygen.

The exposure rate of the 1400 persons in group I (suburban population) was 11.0–22.7% and among the 650 persons in group II (lower population) it was 2.6–9.5%.



Fig. 1. The number of persons exposed relative to the comparison rate.

The exposure rate of the 124 persons in group III (hospital personnel) was 0.1–2.9%. It ranged from 2.9% (2 persons) among the 12 nurses to 0.1%, (18 persons) among the 6 doctors. These percentages may be considered equal taking into account the small number of persons. The relation between the comparison rate and the number of persons exposed is shown in Fig. 1. The exposure was, repeated in cases about



Fig. 2. The number of persons exposed relative to the depth of exposure.

2.5-10 m/min. The number of persons reported at different depths is shown in Fig. 2, which forms an ordinary depth-time curve. The age distribution of the persons saved from January 1961 to July 1961 is seen in Fig. 3. The epidemic rate seems to decrease



Fig. 2. Age-time curve, age-age distribution of 171 persons

with old among age within the groups tested. Among the 1658 persons tested, 171 were reported, but there was only one case of reported tympanic membrane in contact with the pressure test. No other complication was recorded although all persons with the slightest suggestion of disease were subjected to specific examinations. This shows that exposure of normal persons to the hyperbaric environment at the number described here is a safe procedure.

DISCUSSION

Transfusions in the clinical will influence the frequency of upper respiratory infection, which in turn may influence the epidemic rate. Some no significant variation in the seasonal epidemic rates was found, it seems reasonable to assume that such an influence was limited in the area considered here.

Concomitant of the subject's behavior technique according to the instructions may avoid shock, as proposed in order to obtain maximum epidemic rates. The contacts and the use of decompression were put forward by experienced attendants and must have been nearly optimal. Since most of the persons reported were retested once or twice after the application of decompression, in a few days later the results are more likely significant events.

The reported frequency of the three groups might contain an unknown percentage of persons who failed to pass the test for psychological reasons. The behavioral and mental changes of a person suffering pain because of insufficient pressure equilibration and the alleged loss of use of the pain are, however, very characteristic. For this reason, the

adequacy of the post test on most cases, he checked its relevance to the depth gauge because the post nearly always starts at the first few metres of depth, and the subject concerned what reduction took at the same depth in repeated tests. It is therefore reasonable to assume that the rejection rates represent cases with genuine equalization difficulties.

It appears from Fig. 1 that most of the persons were rejected at a compression rate of 0.5-1.0 minute, i.e. during slow compression. It is possible that a further reduction in the velocity of compression might have reduced the rejection rate, but the results of such tests would be of limited value in practice.

The maximum pressure of the test applied varied for reasons unrelated to the compression. The present results indicate that the first pressure plateau corresponding to a depth of 1-40 m. will determine the outcome of a pressure test (Fig. 2). Most of the 1199 persons in groups I and II failed to stand the test at the pressure interval 20-30 m. (34 m. etc.). From this fact it will be reasonable to assume that the results of the test up to 30 and 20 m. will not differ because of the different maximum pressure applied. It seems unnecessary for the purpose of pressure equalization to make pressure tests up to 5 m. etc. A pressure test up to 2 m. etc. (10 m.) seems adequate and will save time and expenditure on compression.

The 11.0%, rejection rate in group I seems to define the magnitude of the fraction of a randomly selected military population which has difficulties in pressure equalization and is therefore evaluated from subsequent service. Only 3.4% of voluntary divers reported had equalization difficulties. Of the hospital personnel (111) 12.1%, seemed to be unsuitable for participating in a hyperbaric therapy programme involving some pressure of the atmosphere.

Group I of the secret seems to have the same rejection rate as group III but apparently both differ from the diver population (1). Since I and II consist of men of about the same age, they are comparable. The difference in the rejection rates (11.0 - 3.4 = 7.6%) is highly significant ($p < 0.001$). The volunteers presented (2) was selected at random, where as this was not the case with regard to the diver population (1). They must apply for the diver training and have often tried their ability to equalize by breath-hold diving. It is likely that at least some persons with equalization difficulties would never apply for such training. Therefore selection seems to be a reasonable explanation of the difference between groups I and II.

The rejection rate among the volunteer personnel in the secret (11.0 - 1.4%) is in accordance with that reported by A. R. Behnke (1948) who found 10-15%, even among 'qualified volunteer personnel'. As already mentioned, he suggested that the fraction was about 20% among the civilian population. Behnke (1948) found that more than one half of the staff of the Bethesda Hospital (Annapolis) could not work on the pressure-tight operating theatre because they complained of pain in the ears and noses in most or the pressure test to more than 4 or 5 metres of depth.

The rejection rate of group I selected as otherwise part of the military divers tested by Behnke. The 5.6% of the selected group II is in accordance with the value quoted by Behnke (above). In a separate selected group III a representative of the general population. The 12.1% rejection rate in group III seems to be a maximum figure in view of Behnke's investigation. This suggests that II is a selected group in spite of

EVALUATION OF COLOUR PERCEPTION STANDARD II OF ELECTRICAL PERSONNEL IN THE PERFORMANCE OF THEIR DUTIES

By Surgeon Lieutenant-Commander A. Rostad, RN.

The reasons for the above experiments are twofold.

Firstly it has been realised that over the past few years as electrical equipment has become more complex, the number of electrical components to be identified by colour coding has multiplied. A high standard of colour vision is an important staff in these days.

This is particularly important for radar technicians when a single cable may carry up to 80% or so internal wires. This has already been recognised in the R.A.F. where with technicians subject to the perception standard II, the highest R.A.F. standard.

Secondly, an electrical rating where colour perception was recorded as standard III was seen in the Optical Unit Department, R.N. Hospital, Hester. Radar recently complained of inability to match coloured cables. Optician's examination showed no clinical abnormality apart from confirmation of low colour perception as standard III.

With these points in view, permission was obtained to carry out an investigation on the personnel of HMS Collingwood. The latter was chosen because of its location in the neighbourhood of Hester's hospital because of the number of radar technicians available.

Check of all medical documents held in HMS Collingwood produced the following results:

| C.P.S. | Number | Percentage |
|--------------------|--------|------------|
| C.P. I | 13/14 | 75.15% |
| C.P. II (Standard) | 92 | 4.73% |
| C.P. III | 358 | 80.77% |
| C.P. IV | nil | |
| Not recorded | 104 | 3.36% |

Total 1938

Colour perception II is the standard given by Professor Ishihara's Plates. This test is not used in the Royal Navy and all colour-vision perception standard II were re-tested and placed in the appropriate categories.

The next step was to evaluate the colour coding used by the Electrical Department. There are two methods of identification. Wires are identified by an identifying band of colour round the middle. In small cables each component is placed underneath a single easily identifiable coloured sheath as the larger cables a number of semi-coloured wires is necessary, the two colours being twisted into a very loose spiral. The plastic covering is non-absorbent. While the single highly saturated colours stand out easily the mixed colours, especially the green/blue and orange/brown are more difficult to differentiate. Poor background illumination and fading of the wires themselves further causes errors.

Before describing the test used in this experiment it is of value to mention the $m - i$ recent evidence taken from the 'background' of the theory of colour vision. It is now generally accepted that colour vision is trichromatic: a theory originally laid down by Young, (1802) revived by Helmholtz (1852) and supported by recent work by Gierer (1947) using micro-electrodes on single cells.

White light may be produced by the mixture of three spectral colours from either end and the middle of the spectrum. There are primary colours. Young stated that there were three different receptors or processes in the retina, each one responding maximally to light of a given wavelength, while sensitive being the sum of the three. Gierer (1947) using micro-electrodes has been able to record the impulses from each



red, green and blue cones and discovered three types of cones responding maximally to 580 nm red, 530 nm green and 480 nm blue.

All tests of colour vision are based on the trichromatic theory outlined above. The instrument used in the Royal Navy is the Munsell colour vision test, which consists of a source of light of known strength, red, green and blue filters, white discharge in pairs, and two sets of apertures 5 mm and 2 mm. Colour perception I is recorded as no mistake with the small apertures at 20 ft. and colour perception II is recorded as no mistake with single large apertures at 10 ft. Colour perception III is not used and colour perception IV is below normal reading.

With this instrument a number of factors affecting performance must be taken into account.

(1) *Adaptation*: Any refractive error must be corrected. The reason may follow: Blue/green light is refracted to a greater extent than red light by a given lens so shown in the diagram below. The chromatic aberration is placed midway between the points of focus of green and red and is therefore in the optimum position. An uncorrected myope will see red closer than blue/green with results as shown in colour perception.

(2) *Darkness*: The brightness of the source of light is kept constant by using a lamp whose output at a constant voltage has been recorded. This is done by the National Physiological Laboratory and a variable transformer is used to keep the voltage at 112.

(3) *Dark Adaptation*: Prolonged dark adaptation of the eye before examination increases the sensitivity of the eye for colour 3-40 times depending on the wavelength of the colour. However since the brightness of the light used in the Munsell test is so

subject's responses were noted, and the subject was instructed to read.

4) For the purpose of this test a full epithelial (retinal) field was necessary to include peripheral defect.

5) *Refracted illumination*. Complete blindness should be excluded.

The test carried out at the Ophthalmic Department, Royal Naval Hospital, Haslemere, as follows.

Each individual had been recorded colour perception standard (II) on entry, was a volunteer and had the rationale of the test explained to him in full. He was then given a number and no further reference was made to his identity. An epithelial, or scotoma, was carried out under the following headings:

1. Family history
2. Refraction
3. Clinical examination
4. Verification of colour perception with special correction of refracted
5. Colour matching test

For the colour matching test 21 pieces of coloured wax 1" long by 2mm in diameter were placed in a lined pencil case (Mau). The first 10 were simple colours and the remaining 11 were two colours combined in an open space as described above. The candidate was handed a piece of wax of similar size and asked to match it on the board under a good light. On completion his mistakes were recorded. The following colours were used:

- | | |
|-------------------|-----------------------------|
| 1) Felted hot red | 14) Cherry red—Yellow |
| 2) Boiled green | 15) Sky Blue—Cherry red |
| 3) Orange | 16) Cherry red—Boiled Green |
| 4) Sky blue | 17) Cherry red—Brown |
| 5) Brown | 18) Leaf green—Yellow |
| 6) Cherry red | 19) Black—Sky blue |
| 7) Yellow | 20) Royal blue—Cherry red |
| 8) Royal blue | 21) Black—Sky blue |
| 9) White | 22) White—Cherry red |
| 10) Black | 23) Sky blue—Yellow |
| 11) Pink | 24) Leaf green—Orange |
| 12) Leaf green | 25) Sky blue—White |
| 13) Magenta | 26) Boiled green—White |
| | 27) Sky blue—Orange |

Results. Twenty electrical ratings of recorded colour perception standard (II) were taken to attend 60 days after refraction. 28 were confirmed to be colour perception (II) on retesting and 12 were colour perception standard (I).

Family history. Five men were found to have a significant family history of retinal defect. The fathers of all four were said to have difficulty with red green discrimination and father being rejected for the Armed Forces. This is to be expected since the defect

pl colorant (case 1), an intermediary made sea-look mixture (transmitted by the 36 distance color).

Perceptual Mixture. Ten candidates admitted to difficulty with color discrimination: eight of them with red/green and two with blue.

Errors. Case Nos. 4, 5, 8, 13, 14 and 15 confused green and brown. Case Nos. 7, 9, 16 and 18 confused red and green. Case No. 2 confused yellow and orange and was unable to reach 100.

Altogether out of 18 colorists, 11 were unable to complete the test (i.e. 61.1 per cent). Most of these were dichromats. This test was carried out on optimum conditions of background, lighting and layout. Under working conditions where illumination is poor and the wires may be used, performance is likely to be worse.

In view of the complexity of modern color equipment and the high standard of maintenance required, it is suggested that all electrical personnel involved in color maintenance should be given as option Standard 1 on entry, if necessary with gloves in the case of efficiency and safety.

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AUTHOR'S COMMENT

I should like to thank Surgeon Captain J. A. Page, R.N., and his staff for their co-operation in making available the maximum spatial and time-lapse facilities for measurement of perceived 1000:1-illumination.

Note: Some type of warning, all electrical nature every candidate who are found to be of P. 88 are required to perform a "Gratic Test" using induction before he qualify for acceptance into the service.

STUDIES OF THE PRINCIPLES OF FLOTATION BY LIFE JACKETS

By J. E. Guile, A. F. Sherburn and Helen M. Fowers

Paper read at the Naval Services Section of the Royal Society of Medicine on 1st December 1966

During the period 1941-43, Macintosh and Pugh carried out a series of trials on the performance of various types of life jacket for the Royal Air Force. These experiments were carried out initially in calm water and later at a pool fitted with a wave machine which produced a 'choppy sea'.

The subject was manikured with a vehicle suitable to and a rafted male volunteer calibrated.

These experiments culminated in the design of the *Survivor 'Mini Wind' or Life Saving 'Mini Wind'* used by both the R.A.F. and the R.N.

In April 1962 the R.N. considered it appropriate to conduct for life jackets arranged a demonstration of the performance of as many garments as possible in calm water. The purpose of this preliminary investigation was to give an indication of the performance which could be expected from a good jacket and to observe the features which were necessarily associated with success.

First let us consider requirements of an ideal life jacket from the aspect of flotation.

1. Flotation must be immediate on water entry; therefore a rapid return to the surface is required after the initial immersion.

2. The jacket must produce rapid self-righting without any assistance from the wearer both at the time of water entry and later if the lay remains the wearer assumes a face-down attitude.

3. The support provided by the jacket must keep the nose and mouth clear of the water in all circumstances.

Life jackets can be divided into 4 main groups according to the type of buoyancy medium used:

1. Inflators: Bulky, relatively little maintenance required
2. Gas inflation: Compact, cheap, must be inflated before use
3. Gas inflation: Compact, dense, can be inflated under water
4. Asphyxiant inflation: Closed polymeric life vest construction
5. Part inflation: Part Gas inflation: Best compromise for small boats
6. Part inflation: Part Gas inflation: (More expensive than 5)

The different types of two-part medium used did not seriously affect the performance of the jackets but the amount and distribution of the buoyancy is very important.

In all these experiments a conscious but relaxed male subject was used. (Height 6 ft 2 in, weight 160 lb).

The preliminary investigation studies were successful in indicating the problems which were as follows:

1. The subject wearing swimming trunks and the jacket under examination allowed himself to fall sideways into the pool from a height of 1 ft above the surface. The distance in which the jacket supported the subject on resurfacing was noted.

2. The subject took 2-3 strokes forward and then relaxed back downwards in the water. The time required for self-righting was recorded. A note was also made of the method of self-righting (i.e. in the longitudinal or lateral plane).

3. While floating on his back in the jacket the subject was observed and the degree of head support and the angle of the body to the horizontal was noted.

Even at this stage it was apparent that a buoyancy of 30 lb or more was required for life jackets with a little less buoyancy were capable of self-righting but took a long time. The importance of the distribution of buoyancy was evident. Those jackets in which the buoyancy was symmetrically distributed fore and aft were stable in both the fore and aft down situations. To produce rapid self-righting the main bulk of the buoyancy must be on the front of the chest. There was also a considerable difference in the performance of twin-lobed jackets, as compared with those having a single anterior compartment. The twin-lobed jackets rotated the subject slowly in the longitudinal plane while those with single compartments produced lateral rotation which was much more rapid. The answer, *Star Wing*, which is a twin-lobed jacket provides longitudinal self-righting which is reasonably rapid but not dramatic considering that it has a total buoyancy of 30 lb.

The attachment of the jacket to the body must be secure and should allow the maximum movement of the jacket relative to the body. It was observed that no movement of the jacket which was probably either due to the design of the harness or to improper adjustment, produced a deterioration in its performance. Lateral support of the head is required as lateral movement of the head decreases the stability of the jacket, non-rotation and reduces the smooth or water resistance. The best angle at which to support the neck is still undetermined and will be the subject of further investigation. The questions of obstruction of the airway and the possibility of rendering the subject inert be considered.

In our experience the optimum flexion angle of the subject's neck is at 45° to the horizontal.

The British Standards Specification for Life Saving Jackets BS 1593 (1961) was published on 15th February, 1961 and its intention is requiring a minimum buoyancy of 30 lb and rapid self-righting, a means to the provision of other features which would mean serious operations. These include such features as bright coloured material (yellow or orange) to aid visibility, a whistle to attract attention, a line and toggle to enable survivors to secure themselves to each other and a lifting hook to make it easier for the rescuer to hold the survivor and assist him into a boat. The addition of a light is recommended for night use.

Design of the Star Wing and its Rival

The same subject was also used in the trials at Hinder. The subject was clothed in short, narrow trousers, socks and shoes so it was considered that the increased mass from the wet clothing would affect the performance of the jackets under test.

A wave height of the order of 18 inches, with a crest to crest distance of 22 feet, was used. The wave was of a sinusoidal form and was generated by large wedge shaped plungers.

The depth of the water was 10 feet.

A steel reference frame was suspended above the water and a movable wave probe was used to record the height and form of the waves in each experiment. An attempt to insure the subject's movement was made by attaching a line to a mouthpiece held in the subject's mouth. Care photographic records of the trials were made above and below water so that the attitude and motion of the subject could be observed.

Although it is not yet possible to produce waveforms figures of wave and man-jet combinations, the visual records and subjective impressions both confirm that the frequency correctly distributed and perceived is the minimum which will produce satisfactory performance in a life jacket, and increasing the frequency to 40% produces a considerable improvement.

It was noted that those subjects which were self-righting in calm water turned the subject to face the waves in every case while those with frequency distributed equally front and aft failed to turn him. As the subject drifted down the tank his legs swung behind him and if he drifted with his back to the waves this he would be self-righting to the short his body would be rotated to a face-down attitude.

Measure of possible objection to the use of a conscious subject in these experiments. There has also been concern of patients at State Mansfield's work facilities and high current currents floating in life jackets in their swimming pool. It was noted that the attitude adopted by these paraplegic patients is identical to the attitude of our referred subject.

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The document has been examined and, to the best of our knowledge and belief, contains no errors.

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Fig. 10. The effect of the concentration of the solution on the rate of polymerization of 1,4-bis(2-methyl-5-oxo-2-penten-1-yl)benzene in the presence of the catalyst. The reaction conditions were: 1,4-bis(2-methyl-5-oxo-2-penten-1-yl)benzene, 0.01 mol; catalyst, 0.001 mol; solvent, 10 ml; temperature, 100°C; time, 1 h. The concentration of the solution was: (a) 0.01 mol/l; (b) 0.02 mol/l; (c) 0.03 mol/l; (d) 0.04 mol/l; (e) 0.05 mol/l. The concentration of the catalyst was: (a) 0.001 mol; (b) 0.002 mol; (c) 0.003 mol; (d) 0.004 mol; (e) 0.005 mol.

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For a complete list of authors, see Volume 4, Table of Contents. MD Joseph T. Hays, MD
Joseph L. Hays, MD, and John J. Hays, MD, Jr., are the principal authors, Hays,
Charles L. Thomas Publisher, Inc., St. Louis, MO.

The manuscript on postnatal parenting benefits, across the world literature on the subject and previous developmental observations early on in infancy of 14 months has paid particular attention to the importance of a child's own taking in to account this type of parental behavior as well as the child's own behavior in the context of the family.

[illegible][illegible]

It is now left to consider only the 'secondary' processes, which first published in the summer of 1964. The first English translation was in 1964, thus was a small pocket book which should have given rise to the same level of success as *Onward*. The book, however, was published in French, Italian and Spanish, following efforts by general practitioners, as a result primarily of the misapprehension concerning its language. As usual in the series, the authors paid no attention to securing a suitable number of reviews or, in the case of *Onward*, to a sufficient first stage, if it is to be applied to English-speaking countries, of a pilot study.

1. The formation of a new, more complex culture for new, different and multiple goals.
2. The development of a more complex, more complex goals for a more complex environment.
3. The development of a new, more complex goals for a more complex environment.

and Thomsen and colleagues were particularly concerned about the possibility of potential biases. There are many potential biases associated with screening. For example, patients who respond to screening may be different from those who do not respond, and screening may be associated with other factors. Screening of patients with a family history of the tested form of α_1 -antitrypsin deficiency is possible, but the test is not available in the United States. When we discuss a patient's screening for asymptomatic individuals, although I understand and appreciate the authors' caution, that the test should be used in a controlled fashion can be helpful, but we do not use this test.

These results are in contrast to the prior studies that, with regard to soft products, most of them are the same task.

[illegible][illegible]

Chapters of the book are divided into: the evolutionary biology leading to the natural selection hypothesis and then a series of chapters of the processes and models of natural selection.

in the past few years. The book, which is divided into 11 chapters, is intended for use by students of psychology. The first three chapters of Part I, 'The Psychology of the Child', are on the general principles of psychology, and the last eight chapters of Part II, 'The Psychology of the Child', are on the specific principles of psychology. The book is written in a clear and concise style, and is well illustrated with diagrams and examples.

The book is written by a leading authority on the subject, and is a valuable addition to the literature of psychology. It is well suited for use by students of psychology, and is also a valuable reference work for teachers and researchers. The book is written in a clear and concise style, and is well illustrated with diagrams and examples. It is a valuable addition to the literature of psychology, and is well suited for use by students of psychology, and is also a valuable reference work for teachers and researchers.

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General Psychology, by Herbert A. Simon, M.D. M.A.C.P. M.B.E.P. Pp. vii + 175. London: George Allen & Unwin, 1964. 10s. 6d.

This is a new book written by a leading authority on the subject, and is a valuable addition to the literature of psychology. It is well suited for use by students of psychology, and is also a valuable reference work for teachers and researchers. The book is written in a clear and concise style, and is well illustrated with diagrams and examples.

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10

Raymond Corbin E. C. HORTON, B.A. (Bard), died on the 14th of May, 1985, at the age of 66 years. He studied Music, UCLP in 1960 and joined the Royal Naval School of Service on the 1st September 1960. He was promoted to Sergeant, Grammar Schoolmaster on 1st November 1963. Raymond Corbin died November 1985. (The Grammar Schoolmaster on 1st Nov. 1985)

Long on capture biology was awarded the title on 20th August 1988 for valuable services to general life. She has inspired *First World War* and *World War II* films in 2001, in *Shall We Dance* (2002).

Miss Barbara Frances BUCKLEY, BSc, CLC(1974), MSc, PhD died on 17th January 1981 in the Royal Naval Hospital, Haslemere, a long illness with the last few years devoted to research.

Has worked at the London Hospital and joined Queen's University in Belfast, where he was
 Director of the School of Medicine in 1950 and joined the Royal College of Physicians in 1951.

She was selected by Congress in 1927 and in 1938 went to our first Congress to become a, and was re-elected twice in 1941. She was president, American of the Royal Red Cross in 1927 and a Member in 1930.

[illegible]

During his long career, the through the quarter century and more has the space of human history will appear to reflect that will be characterized by the rise of a human presence, growing from outside to the human and the presence.

Abstract

A member of the John F. Kennedy Center for the Performing Arts

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Table 1

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1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

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Fig. 6. Same as Fig. 5, except for $\beta = 0.7$.

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EDITORIAL COMMITTEE

Surgeon-Captain S. MILES and
 Surgeon-Captain W. E. STANLEY and his wife
 Mrs. J. R. BARNES

ROYAL NAVY MEDICAL SCHOOL ALTHAMPTON HANTS

Editorial

We should like to draw the last editorial in order to record the Proceedings of the Symposium on Naval Medicine held in April this year at the Royal Naval Medical School. The Summer and Autumn numbers of this year's Journal have been completed.

The year includes papers given at the main Sessions of the Symposium. The Proceedings of the Discussion groups will be published separately as a Naval Medical Bulletin.

The Medical Service General has requested that the following letter from him to the Editors should be published.

Now that the Symposium on Naval Medicine at the RNM is over I think we can look at it with detachment and a critical eye.

Firstly, I want to thank everyone who contributed in any way to the undoubted success of this occasion. I had thoughts of meeting and thanking the many committee men and helpers individually but, if I did I might have cut many people who assisted in the less obvious ways but were just as important in the final outcome.

I have had in my letters full of commendation for the quality of the papers and their presentation.

I was told by many interested observers that they hoped some of the papers would encourage their authors to extend their scope and present them later in other circumstances.

The atmosphere at the presentations was just as encouraging as the interest shown in the discussion groups, and the fear that one might detract from the other was happily undoubted. In all it was a splendid effort by everyone.

It involved a great deal of hard work for many of you but I feel sure you must feel that it was well worthwhile. It was not so much a challenge as the Naval Medical Officer's ability and skill but also demonstrated the wide range of interest and awareness open to us.

Personally we were delighted at the support and help from our Civil Council Staff — who have always been amongst our most loyal friends and helped us much to maintain an open sort of academic atmosphere.

SYMPOSIUM OF ROYAL NAVAL MEDICAL SERVICE

WELCOME, JR. BY TERENCE CATHCART

On behalf of the Royal Society of Medicine, of which I happen to be immediate past President, I would like to say how great I am that the Royal Naval Medical Service has chosen to hold its first Symposium on Naval Medicine in the Society's House.

You are not strangers to us, many of you. Most of you are members and many of you who are not perhaps as a result of the freedom you are accorded will be likely to consider themselves members. You will be very welcome. But you are not strangers here because we have one of our Twenty nine Sections, as the United Services Section and I think it is appropriate that the Service Section of that United Services Section should come here for the first Symposium.

Eighteen months ago we were privileged to see these films made by the Royal Navy on Hospital Air Remountations given at a special meeting, which attracted a very large audience indeed. Then the year before that at the Reception for Her Majesty the Queen, two of your units gave very interesting demonstrations.

Now Admiral Sir Derek South-Parker (Medical Director-General) has said:

Sir Francis Craythorn: I would like to thank you very much indeed on behalf of the RNM Medical Service for being here today in welcome to and our friends to the RSM.

So Victoria, as it is, you will all know the strength of our President, and now in office when not plus to have the Symposium was being touched. Further he has always been very interested in our Service medical problems.

We are indeed grateful to the Society for putting all these excellent facilities at our disposal for these two days.

In the Symposium we have tried to bring a cross section of the work and interests of a doctor in the Navy to you.

As you will see by the programme that is a wide selection and the subjects we have chosen we hope illustrate the diversity of Service Medicine.

Famously medicine knows a large picture of our task matter, but with the limited time at our disposal we have omitted any reference to the aspect of our work, so we feel this subject might not have given the same general interest as the subjects we have chosen.

The first session this morning is "Medicine" and I would like to introduce our Chairman for this session, Doctor Brindley (Dr. Mayall) who has been Chairman of Medicine in the Royal Navy for some 15 years. But of which was in uniform.

SESSION I

Remarks

Chairman: Doctor W. D. W. Brooks

Doctor Brooks: There are one or two points I wish to make before we begin. Time is limited and I must ask Speakers to keep strictly to the time allocated. Secondly the first paper by Surgeon Rear Admiral Holford is a Historical one and is not one to argue discussion.

SOME HIGHLIGHTS OF NAVAL MEDICAL HISTORY

By Surgeon Rear Admiral J. M. Holford

Forty five years ago a naval man, Surgeon Rear Admiral Sir Arthur H.B. stood on this rostrum. He was delivering the first presidential address to the West Section of the Royal Society of Medicine. His last words were: My pleasure, in being permitted to deliver the opening address is tempered only by my diffidence and my fears for your powers of endurance. I think I cannot do better than adopt these words for my own. They aptly express my feelings on facing you this morning.

I think no one can make any reference to naval medical history, especially with out consulting the two volumes by Kessel, Lloyd and Croket. I have drawn heavily on these invaluable source books for material and wish to acknowledge my indebtedness straight away. But although I have drawn on them for a number of unrelated facts I would not wish to saddle them with responsibility for my misapprehensions.

The real peaks of achievement by the genius of the past, Clement Wootch, Lord Thomas Blount and the rest have been so well covered that you would scarcely think me for enumerating such familiar ground. I would like rather to say a little on a somewhat more tangible subject. What can we deduce from historical material upon about the naval doctor's attitude to his own profession? And how has this attitude developed with the passage of time?

To a considerable extent this attitude must have been governed by the opportunities which naval medical service appeared to offer in the context of medical practice of the day. This judgment would affect the nature of man's response to Science. In times of great opportunity good men would be attracted and important progress achieved and learnedly. It is clear that this is a situation of positive feedback resulting in unstable equilibrium. One would expect progress in the job, by means of the medical branch and a corresponding response both in the standard of practice within the branch and in its own internal philosophy. I think the historical record shows clearly that something like this has indeed taken place.

It would probably be foolish to attempt to push the matter further back than the beginning of the 18th century. One can scarcely picture any corporate spirit among men going medical even earlier than this. By the middle of the century, however, not going medicine and surgery was a noticeably distinct part of the profession, though an organized medical branch of the Navy cannot really be said to exist until 1805.

It is perhaps desirable to depress a brain here to remind you of the marked distinction between physicians and surgeons, which was a salient feature of the profession in the 18th century. Broadly speaking, the physician was thought of as a scholar and a professor, while the surgeon was looked on as a practical craftsman. This distinction can be traced at least from 1215, when Pope Innocent III, that formidable prelate, who placed England under interdict on the issue of King John, at the Fourth Council of the Lateran laid down that no deacon, sub-deacon, or priest may exercise any form of surgery which involves dissection or incision. This ruling closed the pathway of surgery to the only educated class then in being. The subsequent rise of the barber-surgeon has of course, obscured a good deal of historical study in this field. As far as the Navy was concerned, the majority of its medical men passed as surgeons, after a rather perfunctory examination by the Company of Barber-Surgeons. The more able and ambitious few took a medical degree and emerged as physicians. It is for this reason that the more advanced men early all went from one known source to us as physicians, but Lord, Traillor, and the rest had all been surgeons in their day. The Navy, being a highly conservative organization, tended to retain traces of this distinction long after it had lost most of its meaning to the profession generally and indeed after it had officially been abolished in the Service. This is well shown on the boards in my office which record the names of my predecessors in charge of Hatter. In the period 1870-1910 the physicians not unlike the surgeons by assuming like I do! I may say, however, that the Navy seems to have no shell of the unknown now and perhaps goes too far the other way. Most officers including myself have been in charge of Hatter since the end of the war, none of them have been surgeons.

But to return to the beginning of the eighteenth century, naval medicine, at the time was at a low ebb. It appears to have been in the grip of William Coakburn (1646-1726). Few outside the past writers of history have been so captivated by contemporary as his book, *Sea Diseases, Ulcers and Cholera* (by Coakburn was not an original writer, not an attractive character, but he was well born, extremely influential, and very successful in private practice. His self insurance was nothing but his words were out of date, even when he wrote, and his sympathetic concern with this world responsible for the absence of any notable advance in naval medicine during his long reign. When he died he was described by a contemporary as an old and very rich man. He is, however, the only naval physician ever to have been buried in Westminster Abbey. A year might see a better time.

The great Coakburn died. Lord joined the Navy. This is I think only one sign of opening, of interest in naval medicine which continued for the rest of the century. It was a time of great expansion. The foundations of surgery were being laid

Civilian organizations all over the globe were in progress. Young surgeons must have often had service as a guest through various opportunities. General experience was rich and varied. Was there single opportunity for surgery and the results were often better than in those based hospitals. Facilities in ships may have been poor but they were at good as anywhere else and the skill which great scientific contributions were receiving as the young graduate was two centuries away. Thus, the period from 1760 to the Napoleonic wars was one which saw a good many more of real worth enter the Service.

The great achievement in the founding of hospitals as the promotion of ship hygiene, and in the beginnings of welfare organizations which led to the establishment of Land Transport, Richardson and Blane have been widely publicized. In a few ways to distance from the many incidents when the rank and file of surgeons were really busy. I think they were probably pretty good. A number of political incidents appear by chance like the students preservation of funds which seem to reflect the passion of thoughtful men observing their patients with diligence and learning from their experience. In 1766 Laurence Blane, an assistant surgeon on H.M.S. described his observations on criminal legislation in important studies. It had been the custom to leave the prisoners long so that they could be gently pulled away in the morning apparatus. Blane gave the trade of the idea of cutting them short to a fixed bed, he appears to have been the one usually to try it. In his own words the prisoners sometimes became troublesome and scratched the bars. An intimate friend of mine, a surgeon of great ability, proposed to cut the ends of these off close to the knee and then leave them to themselves. By following this plan we have seen things settled in the course of ten days. The short legs were then left in generally made to keep out by a small opening in a short time without any trouble in the patients being sensible of pain. On 9th October 1805, Samuel Black Jackson aboard H.M.S. *Porpoise* attempted suicide by cutting his throat. He was unsuccessful. Surgeon David Fleming, who denied the wound, stated that the water coat of the prisoner caught away had been damaged. On 17th October the crew burnt during a fit of vengeance. Fleming immediately cut down and took the crew. He commented simply "I had never heard of such an operation being performed." One cannot feel other than profound respect for a man capable of such actions and resolution in an emergency, and there is indeed no record of any further legions of the common world. Another naval surgeon died of this period in the metropolitan hospitals, a surgeon performed at the Naval Hospital, Annapolis in 1808 by Surgeon Ralph Corning. This was done on a 21 year old sailor who had been hit in the shoulder by a cannon ball. Both these persons made complete recoveries.

Another feature of contemporary records which to my mind, speaks in favour of the moral support of the late Georgian and Regency era is that they so frequently emphasized. The surgeon of H.M.S. *Puck* in 1840 wrote: "gentle and my discharge or death will once put us and to my trouble." But in 1840 wrote: "Nothing, as it now stands, can drive a young man into such a serious but want of education or want of friends. Such instances could be multiplied, and in my opinion they have been much multiplied. From the point of view of a contemporary civilization

in governmental service always have been useful in some way or other. Many would say they still are. The present needs a service of men with sufficient vision to comprehend a sign of trouble and the first that they see there is to insist that the opportunities it offers are enough to outweigh its frustrations for them. It is those periods when the future is clear and administrative difficulties arise from only outside that we should look on with suspicion. It is a significant fact at the same time as the complaint I have quoted. Sir Gilbert Blane was writing: "Surgeons are perhaps more regarded in our service than in that of other nations."

To sum up then for the eighteenth century: was a time of growth and progress for the medical sea service. Its heritage and pride is still seen in a guild in the Napoleonic wars. Therefore a change seems to have set in, in which we must now join our historians.

It is customary when a people war for the nation to feel that they have paid half the war in and were used to men with added to demands, officers. In the period we are discussing this feeling culminated in the Reform Act of 1832. The classification of empire was continuing so that the Navy consumed a service of prime national importance. Nevertheless its place in the forefront of public consideration inevitably receded. To the practical medical service the Surgeon must have seemed less important than formerly. The methods of practice had become unaltered. The discomforts of sea life would seem more obvious without the stimulus of war. At the same time on shore hospital conditions were improving, public health was rising in the world, and the mounting wealth of the industrial revolution was reflected in greater rewards in private practice. It would not be surprising therefore if the medical branch found its appeal declining. The branch did indeed have its difficulties. Its officers were called as quakers by an order of 1833 which forbade surgeons to attend the King's service. This brought forth a vigorous and successful protest from the redoubtable Thomas Wakley, editor of the *Lancet*, that on the whole the status of the naval surgeon remained good. Modestly the Navy adapted itself well to the Chinese war and stood with the courage of the Chelsea pandemic both before and after a good deal better than the Army.

The unexpectedly high morale of the branch in the post-Napoleonic years may have been due to the much publicized successes of the surgeon cadetsmen. The crowded magazines and stores and intricate explosions, primarily undertaken for political and commercial purposes, were recognized as offering great scientific opportunities and the surgeons who explained them often had to wear the additional hat of the naval surgeon. The best known names are Richardson, Harker and Huxley. Of these only the last named made his permanent career in the Service, starting from the post of senior physician at Harker in 1845.

The analogous decline seems to have set in after the Crimea. By the early 1870s it would appear that the medical branch had become largely unattractive looking and out of touch with the main stream of medical progress. A telling illustration of this can be seen in the pattern of work in Harker. In 1869 only fifteen operations were performed in the hospital, of which the most serious was the amputation of a finger — and this in spite of the fact that amputations had been standardized there by Richardson in 1852 and the Listerian carbolic spray in 1868. I do not think the

three-way struggle will be explained entirely by the fact that the Inspector General (Sir H. Hilditch), Lloyd and Croker comment on the difficulty of finding any significant precedents in the latter part of the century, and so I can confess I regard this as a bad sign. Perhaps we can find a clue in the title of letters from the great Sir John Richardson (now in retirement) speaking at the opening of his life to Florence Nightingale. He talks of a doctrine of government for which he still has no completely adequate therapy. He refers to the difficulty of introducing the improvements of modern science into matters of ultimate thought which every suggestion must pass round the head of the officer is called upon to decide regarding a matter of which he knows nothing, all the reasons for the change having floated away in the progress towards the proposed. But in the same conversation Miss Nightingale may have put the matter more truly on the head. The words, 'Trinity she said' 'in the rear of all evil'.

There is no real evidence of any change until an explosion occurred in 1897. Inspector General Trenchard disposed with the lack of training of medical officers and the complacency of the Medical Department towards the deterioration round the matter in a letter to *The Times*. The highly irregular action engendered a spirited correspondence. Trenchard made such a mistake of himself that the Medical Director General wrote him after only 12 months in office. But the damage had been done. Daylight was let into dark places, to the great benefit of the branch.

Perhaps Trenchard's intervention only triggered off a change which was coming anyway. Forard of the Navy List suggests that by the turn of the century naval medical officers were starting on the upward path again. In the problems in a while the most capable advances of the period were in surgery, so it is perhaps natural that the surgeons should now lead the way. In 1900 Fellowship of the various Royal Colleges of Surgeons started to appear in the Navy List and they slowly increased in number up to the start of the 1914 war. I am sorry to say that the physicians were slower off the mark. The nomination for Membership of the Royal College of Physicians of London was established in 1879, but its first naval medical officer to present did so in 1911. (See Eugene Horace Brydon 188).

At the beginning of the 1914 war the Journal of the Royal Naval Medical Service, — now *Naval Medicine* — was founded. The decision to start a had been taken a little before the war, and this I think is clear evidence that the medical branch at this time had renewed confidence in itself and felt it had a contribution to make to medicine. The initial editorial is unfortunately rather verbose about the back ground of the Journal, but it does contain one significant message which bears out my view. It is well known among medical officers that much of the scientific and medical material in their official reports and other papers, some of which deserved wide publication, has been unnecessarily buried in former times. The first article in Volume 1, No. 1, was by Jack Watson R. L. Johnson on the French Anæsthetic Experience of 1900 (7). This is an area of experience to which the branch is well contributing. In the two years the Journal contained articles from such well known persons as Humphrey Rolleston, Leonard Christie and R. J. Walker. The

Journal has played some notable contributions to epidemiology from Sheldon Dudley and others two centuries in the future.

The 1914 was not at all quiet; the first in history in which the whole nation was involved. The extended contact with these civilian colleagues gave rise to a wish in many members of all the medical services that they should not allow themselves to sink back into isolation again. In the event, the post war situation which some of us are old enough to remember was too much for them and during the twenties and early thirties the services implicitly passed through the dilemma again. However one of the expressions of hopeful endeavour just after the war was successful and has been of much help to the image of the medical branches of all the Services ever since. That was the foundation in 1919 of the United Services Section of the Society. The moral connection with the Society is in fact rather older. Sir Gilbert Blane having been President of the Society in its earlier form from 1813-1815. When our Section started in 1919 the Navy had the honour of providing the first President in the person of Sir Arthur Hill. The first meeting was the same Dwyer Hall who was previously mentioned in the first report, BMJCF. The Section has certainly been a source of stimulating contact with general medicine to me throughout my career, and I do not doubt many others feel the same. It has held over 170 meetings and has covered the widest possible range of medicine applied to the art of war. It is interesting to note that the Navy was still pre-occupied with surgery, one of its earliest papers in the Section being by General South on this disease. Looking back on the situation twenty years ago, I feel fairly sure that I was of much greater use of service on a public school just of those days than anyone does serving in the Navy!

Oddly enough although the spirit of the Society must be considered one of hope, as is from the pages of its Proceedings that I take some of my evidence of making in the letter was proved. I quote from the presidential address to the Section in 1935.

To the newly joined medical officers I would say: Do not forget that though we have to do a considerable amount of paper work in the Services the local civil practitioners' does not welcome a share of it. If you have to correspond with him on a Service matter let him down as lightly as you can. He is apt to be busy all day and most nights. If you can settle a matter by seeing him, do so and get to know him. You will find a wealth of valuable knowledge and experience very freely at disposal for your acceptance of you grant your civil brethren with the benefit of friendship to supply the necessary formalities of Service correspondence. When I first contemplated this melancholy vigils of our civilian brethren I found it hard not to brush away a tear.

"When and how did the reversal come?" For several I take it that has been. I think we can trace two main contacts. Firstly there is a tough meeting with the surgeons' association a century ago. During the thirties came the drawing reduction close to speed perhaps has never reaching that in the broad fields of applied physiology there was work to be done which the Services were better placed than anybody else to do. In 1955 we have the first record of oxygen consumption in man from Surgeon Lieutenant W. A. R. Thomson as brilliantly followed up during the war by Donald, and by the start of the war there was a well established corpus

of work in underdeveloped medicine and in medicine. Secondly, in the Second World War the phenomenon we have noted so far, namely the utilization of civilian medicine was even more massive. It has been our good fortune that the medical understanding that mobilized has not been offered as liberally to welfare work. We have been nobly served by our civilian consultants by the Royal Naval Reserve, and by the Medical Research Council. I think we have been helped by the changing pattern of the Service, by the relaxation by executive authority that the nation, Mrs. Pughson in a much more a heart — and consequently a family.

So it seems that we now have more health safeguards than ever before against coming on to ourselves and losing the main stream of our professional care as by. We can perhaps make the medical claim that we have learned something from our past mistakes, and so can look to the future with hope.

I may have been rash in bringing my shoes up to the present day. Westlake wrote that shoes need time even after they have been done, so he seen and heard. We are too close to the past of our own working lives to judge those trials. But I remain an optimist.

I would like to close by referring to one of our greatest later figures, Gilbert Elliot. One of his objects in founding his Medical was that the observations of naval medical officers should be recorded and published, and this is part of the object of our Symposium. He also mentioned that medical officers should engage in private practice. In his day this was of course the only way they could broaden their experience. In the course of our own day I think we are following his precepts, so we may hope his health shade is looking down on us with approval.

PULMONARY SARCOIDOSIS IN THE NAVY

By Surgeon Commander John Barltow, RCN

Sarcoidosis in the form of an acute disease was first described separately by Hirschman, who named it after his patient Meyerson and by Rosen in 1939. In the same year Bock described the disease as sarcoid under the supposition that they were allied to silicosis or postinfectious conditions. In 1938 he changed the name to foreign military fever. The controversy as to aetiology remains today though on a different line.

The disease may well spread and this is illustrated in the present series in which the predominant lesion was pulmonary. Although every organ may be involved in the disease and this in the past has led to a multiplicity of names for the condition in the various organs involved. The skin may become involved or bones may be involved. There may be cerebral, ocular or nodular lesions in addition to the common involvement of lungs and lymph glands particularly the thoracic glands. Occasionally these lesions give rise to a multiplicity of symptoms and the diagnosis is often difficult and in doubt.

The pulmonary changes in Sarcoidosis resemble one of the most conspicuous manifestations of this disease but no longer rate disease. The dominating pathological feature is a non-cancerous granuloma which is non-specific and may occur in almost any organ or tissue. But it must be stressed that the characteristic histological appearance is not specific and may be produced by beryllium, mycobacterial infections and the type leishmaniasis. In the lungs the similarity with tuberculosis and lymphogranuloma may be marked. The diagnosis of sarcoidosis is tentative and sarcoidosis in sarcoidosis is well documented and occurred in two cases in the present series.

AETIOLOGY

The aetiology of the disease remains obscure. The Nickerson-Kern test is frequently positive in clinical sarcoidosis and many authorities think that it is a specific test for the disease. The recent large scale analysis by Davies D-Army Hart and his colleagues has focused attention on the subject for in Scotland and in 1940 Sarcoidosis is a disease in which the cause must be sought so much on the almost certainty of the fact as in external causative agents and this is the basis on the one of the present controversy as to aetiology. Sarcoidosis remains a disease which cannot as yet be reproduced in animals and the investigation of these factors associated with it in the host is difficult.

MATERIAL OF SERIES

The material for the present series was derived from the in-patient records of all patients in whom a clinical diagnosis of Sarcoidosis was made between 1952 and 1964. These cases have been very fully investigated clinically and histology.

only. Most have had only one or more as positive areas, and in an adequate or adequate negative and no negative. Some might cases were excluded as insufficiently studied. Two cases were excluded from the main series, subsequent to the 1950-51 survey, which lacked the diagnosis as fibrotic granuloma of lung. A record of a positive biopsy test was found in the records of only one case and this case of record. Seropositive is not included unless an pulmonary lesion was demonstrated. One other case of established Seropositive was excluded since no pulmonary lesions were demonstrated.

The 40 cases included in the series with pulmonary lesions in which a diagnosis of Seropositive is considered to have been established have all been observed and investigated in the Chest Clinic at Harbor. Most of the cases have both been in employment by the Los Angeles County, both as physicians and as pulmonary nurses, and we are grateful for his constant and available help. Most of the cases have been observed for less than six months and the majority for over 12 months. The longest for 14 years and many for over 5 years. There is where the lesions have resolved, and where is still varying, have remained after the MBS survey. None of the cases have died. Some of the cases were resolved and four of these are still being observed in Chest Clinic and the records of these cases have been obtained and reviewed and their further X-ray examination. Eleven per cent of the cases are still under active surveillance within the Service. A histological study was has been established in only 10 per cent of these cases with pulmonary lesions by biopsy with biopsy by skin biopsy and in one case by lung biopsy. The cases with Mantoux tested with old Tuberculin. In only one case was no result available. The results showed that 50 per cent of cases were Mantoux negative. (Figure 1 Table 2)



FIGURE 1
Table 1

ANALYSIS OF CLINICAL HISTORIES

I should like to restate briefly the clinical features of the cases in this group. Nineteen of the cases in the group met the entry criteria, one was excluded as it did not fit the diagnosis, one was excluded as it was not included in the series. One case was seen on the Chinese division of the RN and one as a white South African coming with the RN. The remaining cases were European, four being female. Succession in occurrence is childhood and the age distribution of cases is shown in Table 1 (Figure 2). Only one case occurred in a Boy Scout, whose lesions persisted for 20 months and has since remained well in the RN. The oldest case was in a post-war Royal Marine with focal periorbital changes which resolved with medical treatment. Two cases were seen in Officers — one a White Officer. The bulk of the cases, 12, were seen in serving RN RM and WRAF personnel predominantly in the 20-39 years age group. A statistical analysis of the incidence rate per 1,000 of serving personnel has not been made since the incidence is extremely low and the reporting rate negligible.

TABLE 1

| Age | 0-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 |
|-----------------|------|-------|-------|-------|-------|-------|
| Number of cases | 0 | 10 | 0 | 2 | 1 | 1 |

Figure 2

SYMPTOMATOLOGY

The symptomatology of the disease is shown in Figure 3. 41 per cent of these cases of pulmonary histiocytosis were originally discharged to hospital for investigation as the result of MMF examination. Of the 16 cases which presented with symptoms, but were found on initial chest X-ray to have changes subsequently established as pulmonary histiocytosis, the variety of presenting symptoms was intriguing. Two presented with pain in the chest, 1 with dyspnoea and 2 with a cough. One presented with numbness of the legs and one case was found to have evidence of the ankles without systemic evidence. In this case the typical pulmonary changes, both peripherally lung changes and thoracic lymphadenopathy persisted for 1 year before resolving without medical lesions.

Two cases presented with arthritis and one with axillary and another with cervical lymphadenitis. One case presented with parotitis. Only two cases presented with skin lesions. One case presented with flushing of the face.

In addition to these cases four cases developed vitreous but none of these showed any radiological abnormality. These cases started minor renal infections but the BUN's were normal and the kidney sections were of normal size. These cases developed eye signs of sarcoidosis during the course of their disease. One case had symptoms which were investigated by H&O; the finding was normal.

In the whole series 32 per cent had their heads X-rayed but no changes typical of Sarcoidosis were found.

CHEST X-RAY CHANGES

The X-ray changes in Pulmonary Sarcoidosis are diverse and the various combinations of lesions which vary through the course of the disease present a complex picture. Diagnosis is difficult without careful clinical evaluation and serial X-ray observations. In general bilateral lymphadenopathy is more suggestive of Sarcoidosis than tuberculosis and in 10 of seven cases in only three cases was the hilar lymphadenopathy predominantly unilateral; one had previously had tuberculosis and one has subsequently developed the disease after resolution of the changes ascribed to Sarcoidosis.

PRIMARY CHANGES ON P.A. CHEST X-RAY IN SARCROIDOSIS

(Problems arise in recording re-investing of chest X-ray films)

Thoracic Lymphadenopathy

HILAR

Bilateral

R. +

L. +

=

=

Unilateral

R. +

L. +

PARATRACHEAL

R. +

L. +

Ext. X-ray

Further films

Paratracheal Changes

Extensive-paratracheal changes

Miliary Nodules 1-4 mm

Larger Nodules 4-8 mm

Coarsest diameter

Pulmonary Fibrosis

A. Lines

B. Lines

Summary of Course of Changes

Figure 3

The X-ray (Fig. 3) of the lesion in the lower lung demonstrated that the opacity is located on a pleural surface (Fig. 3). This serves to emphasize the changes which can occur at some stage of the disease and in almost any localization. No evidence was found with the roentgen such as the flow of lymphatic drainage but the recording was necessary in order to obtain systematic recording of all the changes present during phases of the disease.

The analysis of the type and distribution of the thoracic lymphadenopathy was recorded as shown in the profiles. The paravertebral changes recorded represent some description. The axillary granular changes are the most difficult to evaluate and describe. Their most constant and prominent feature is an overall haze in several places appearing with a variable background of small solitary deposits and a few vascular pattern. The smaller solitary nodules which represent the rounded type of change are non-specific. The larger nodules remain discrete and resemble nodular carcinoma or secondary deposits and their differential diagnosis is complex. The confluent densities are less discrete and resemble the shadows which occur on the pneumothorax and various lung diseases. The changes of pulmonary arteries are non-specific in its A and B lines, though it is thought that the A lines are caused by vessel wall thickening with several lines in the disease. Early, a definite team were noticed so as the recognition of these lines.

Thoracic lymphadenopathy is usually said to be the earliest pulmonary change, but in this series as reported above in only 44 per cent of cases, as noted in X-ray. More over 90 per cent of the cases showed some form of thoracic lymphadenopathy at some stage of their total X-ray observation. The type of lymphadenopathy is variable. Thus, in 54 cases bilateral hilar lymphadenopathy was present. This could be marked (Figure 4 Case 16) and this data shows the typical large paravascular glands. The glandular enlargement could be slight (Figure 5 Case 70). An analysis of the types of lymphadenopathy showed marked unilateral hilar lymphadenopathy in only 5 cases and in three it was right sided (Figure 6 Case 124). Parenchymal lymph node involvement is said to be common in *Sarcoidosis* but (Figure 7 Case 40) it was started in only 6 cases. It occurred also with hilar lymphadenopathy (Figure 8 Case 79). A discrete miliary nodular lymphadenopathy is rare in *Sarcoidosis* and was not seen in this series. Calcification is usually uncommon in proven *Sarcoidosis* and occurred in only 7 cases. The cases associated with tuberculosis.

PULMONARY PARENCHYMAL CHANGES

The pulmonary parenchymal deposits are typically bilateral and extensive and tend to spare the apices and the periphery. This was confirmed in the present series by serial reading of the X-rays in which parenchymal changes occurred at some stage of the disease.

The distribution and type of parenchymal changes was recorded as a profile of the lung fields in which each lung field was divided into upper middle and lower zones. And each zone was further subdivided into a medial and lateral part.

The percentage involvement of these zones shows that the distribution of the axillary granular and small solitary deposits were the most widespread changes in



FIGURE 1
Chest X-ray showing
normal lung expansion



FIGURE 2
Chest X-ray showing
normal lung expansion

Figure 1. Figure 1B
Right-sided pleural
effusion/atelectasis



Figure 2. Figure 2A
Bilateral pleural effusions



FIGURE 10. An anteroposterior view of the thorax.

the lung fields sparing only the extreme apices. The lower medial lobe(s) were predominantly unilateral and the median diameter varied to 1.5 cm (Fig. 10).

The commonest parenchymal change was solitary nodules of less than 4 mm in diameter. 18 per cent of the cases showed this parenchymal change on initial X-ray and this is the high incidence compared with other reported series. Indeed on this series only 8 cases showed no parenchymal change (not including pleurisy) at some stage of their disease. Only two cases showed (Figure 9 Case 2) reticulogranular changes on initial X-ray. A lesion was seen infrequently and if seen not at all in the present series. Miliary nodulation of the smaller lung (Figure 13 Case 26) was the commonest parenchymal change. The type was variable (Figure 11 Case 39) but clearly differentiated from the nodules classified as larger nodules (Figure 12 Case 11) which were rare. Many cases showed more than one parenchymal change at some stage of their disease and the commonest transition was from clearing and the development of (Figure 13 Case 27) confluent nodules. The appearance of these nodules was variable (Figure 14 Case 76) and in many cases the parenchymal changes waxed and waned though the lesions observed in this study were generally mild and showed little disability or severe symptoms.

Pulmonary findings were uncommon (Figure 17 Case 1). It was found in one case with arthralgia, suggestive of a symptomatic process on initial X-ray. Extensive fibrosis (Figure 16 Case 20) was seen in only two cases. Such a picture is not specific and would be difficult to evaluate on an initial or single X-ray. The size degree of pulmonary changes on initial X-ray may be summarized in Table 1 (Figure 17). Discussion on the course and prognosis of fibrosing interstitial lung seems rarely be limited to a series in which no cases have died and only 7 have been intubated from the ICU. No pleural effusions were seen in any of the cases. Despite the mild symptomatology of most of the cases, 56 per cent were treated with prednisone at some stage of their disease. Many cases showed more than one type of pulmonary parenchymal change, either in combination or successively during the course of their disease.

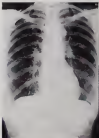


Figure 17. Case 1. Fibrosing interstitial pulmonary changes.



Figure 1. Chest X-ray showing bilateral rib fractures and a large right-sided pleural effusion.

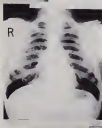


Figure 2. Chest X-ray showing bilateral rib fractures and a large right-sided pleural effusion.

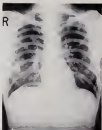


Figure 1
A large, well-defined, rounded opacity in the right lung field.



Figure 2
A large, well-defined, rounded opacity in the left lung field.



Figure 2. Bilateral
pulmonary infiltrates.

Figure 3. Bilateral
pulmonary infiltrates.





Figure 1. Effect of treatment on body weight.

SUMMARY

The chest X-ray observations and clinical records of 44 cases of lymphomatous pleuritis, pulmonary lesions, and mediastinal lymphadenopathy were analysed.

The most common change was thoracic lymphadenopathy, prominent in the hilar and mediastinal stations with solitary nodules which spread the spaces. Many of these cases resulted in long further changes but many developed confident evidence that substantiated the lymphadenopathy. Few cases progressed to fibrosis. A few cases showed A lines but no B lines were seen. The absence of B lines in the series of cases confirms the findings of Unsworth who found no B lines in a series of about 75 cases of known pulmonary metastatic involvement for the specific purpose. No pleural effusions were seen.

In many cases which were symptomatic the most fixed paraneural changes developed and eventually involved leaving only minimal residual lesions, most or almost completely. Few cases presented without some form of thoracic lymphadenopathy and in some the pronounced paraneural changes, and extensive granular shadows occurred this was the most widespread paraneural change involving all cases except the extensive spaces. The larger nodules 4-15 mm in size, occurred least frequently of the paraneural changes and in general their distribution tended to be basal and more densely distributed in the lower lobes. The confluent shadows occurred most frequently in combination with other paraneural changes and many cases showed this type of lesion at some stage of their disease. Extensive hilar lymphadenopathy was the commonest change to occur alone and in these cases the hilar enlargement often persisted in size and persisted for some years before subsiding.

CONCLUSION

The series shows a high incidence of pulmonary changes as noted from X-ray compared with more often reported cases. Despite this the series shows a low incidence of residual pulmonary fibrosis. In view of the earlier pneumonology a high percentage of cases were treated with steroids and considering the fixed paraneural changes in some of these cases the low incidence of residual fibrosis may be related to this therapy.

The series confirms that pulmonary lymphoma is generally a mild disease of variable course in which the lesions usually resolve completely. It is of interest that BME records provided a useful assessment of both the preceding and subsequent pulmonary X-ray appearances.

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are well being followed up in Graham Chest Clinics and I think, these cases were discharged because they had gone away symptoms and there is certainly one case who has been treated for a considerable number of years since release from the Service.

Says Capt TURVILLE: *Could Commander Marston please tell me the average difference from this with these cases of sarcoidosis?*

Says Col. HARRISON: I cannot give you the exact figure, but some of the cases were in hospital for about two months and others that they were retained by continued duty. A few retained for a second rather shorter hospitalization than all those who have been retained in the Service have been on restricted duty, but not all day for more than their initial hospitalization and most of these were two or three months but not longer.

Mr. Chairman: I believe that there are racial differences with this disease and sarcoidosis has a very high incidence of occurrence. I wonder if you or Surgeon Commander Marston know if there is any race where sarcoidosis rather does not occur or is comparatively higher?

Says Col. HARRISON: I don't know of any race where Sarcoid does not occur but there is a particularly high incidence of it in North American negroes.

Dr. BRIDGES: There is an interesting comparison with negroes in that negroes in underdeveloped parts of Africa have a relatively lower incidence of sarcoidosis than negroes in the United States of America and it has always been the relation ship between the relative absence of sarcoidosis in primitive people who are relatively unexposed to infection and the relatively high exposure of American negroes to tuberculosis that is of interest. It does seem that where there is a high exposure to tubercle the peculiar racial reaction also seems to occur more commonly.

Commander Marston: Although you have said the onset is usually, most in winter, I want to ask if you regard this reaction as an infectious or parasitic, or as regards pulmonary sarcoidosis, or whether you attempt to make a connection with BCG or other vaccines and if so what was the result?

Says Col. HARRISON: No attempts in Mauritius connection with cattle with these cases of sarcoidosis. When I started to prepare this paper I thought I would try and see how many of the cases had had BCG and I found it very difficult to trace the records. I know BCG is given at Galle and uniformly getting 100% and in St. Paul's would have had BCG inoculations and presumably would have converted.

There was then some general discussion by Professor Donald Archibald Ramsford and Dr. Lionel Sandy on the generalized effects of Sarcoidosis and its prognosis. Professor Donald postulated that some of the effects in the lungs were permanent despite the histological changes of the pulmonary changes and that respiratory function, instead, were of importance in the sarcoidosis. He suggested further research into the causation of Sarcoidosis and Tuberculosis. He said that

it would be of particular interest to obtain histological evidence of amyloidosis, including long biopsies of those observed around with pseudochyall lipid changes whenever possible.

Surgeon Commander Williams asked if in selecting the rather high number of cases for steroid therapy any consideration was taken as to whether there was hypothyroidism in that particular lot.

Surgeon Commander Houston stated that as far as he knew from the routine blood tests had been selected on the basis of their blood para/protein changes or because they had paraneoplastic symptoms at that time.

Dr Brooks for Chairman summed up the discussion, particularly on the effects of Mifampride therapy in cases of interest that had had BCG inoculation in the past.

AN ASSESSMENT OF THE FIRST FIVE YEARS OF THE RETENTION OF SELECTED TUBERCULOUS PATIENTS IN THE ROYAL NAVY

By Surgeon Commander C. W. J. Under, R.N.

INTRODUCTION

Tuberculosis has always been accepted as a Naval disease due to the peculiar environmental conditions of Service life. As a result of improvements in diet, ventilation and thermal comfort, the environmental conditions and standard of living cannot be entirely responsible for the increased incidence in a specially selected population.

The original approach to preliminary tuberculosis in the Royal Navy was that all cases diagnosed as such should be avoided forthwith.

In 1942 this was modified with the introduction of a scheme to retain certain selected cases who were of particular value to the Service and in whom the prognosis for recovery and return to duty was good. Under this scheme most cases of preliminary tuberculosis were avoided.

Later the Long Term Treatment Scheme was introduced under which all cases of tuberculosis were given treatment in hospital, sometimes for lengthy periods even if there was no prospect of their return to duty. This was presumably a first step measure only and was designed to safeguard against all dangers to the establishment and maintenance of these patients in civil life.

In 1950 at the annual conference of Specialists in Chest Diseases the question of disposal of cases of preliminary tuberculosis after full courses of lessons and no evidence of residual infection was discussed. It was felt this type of patient was a more formidable risk than one with pleurisy effusion. Many of the patients having recovery were in a comparatively older age group and were the more valuable men to the Service. It was recommended that selected patients should be retained on the Service under observation for one year before final clearance was made. In a large mass of officers dealt with in that way there had been only two relapses.

Despite the fact that the Royal Navy has always been particularly vulnerable to respect of the spread of preliminary tuberculosis and although the rate of infection was much improved it was still somewhat higher than the other two Services it was felt arrangements could be given in this regard.

In December 1951 these Committees approved a revised scheme of treatment for persons suffering from primary tuberculosis whereby it was hoped to retain particularly valuable officers and men who would otherwise be evacuated. It was not the intention that prolonged treatment should be provided for untreated persons found to be suffering from tuberculosis within a short period after entry.

The outbreak of the Chest Unit at Royal Naval Hospital Haslem, was transferred to the Royal Naval Hospital Haslem, in 1954, but as none of the men were but all cases requiring surgery plus those 12 years it appeared expedient to retain a separate unit. It was thought desirable both in the interests of the Service and the patient that: (1) a convalescent ward should be maintained and for this reason all cases considered suitable for retention were to be seen by the Naval Commanding Officer Haslem who would visit the Royal Naval Hospital Haslem, once a month. (2) those cases of who were not considered to be suitable for retention were to be transferred to a civilian main hospital as previously but remain in a Naval Hospital under Naval supervision and discipline. For those cases where there were compassionate considerations, all cases recommended for retention were to be transferred to the Royal Naval Hospital Haslem. This would facilitate consultation with the Consultant Physician and Thoracic Surgeon. Officers would continue to be treated in the King Edward VII Sanatorium, Haslem.

Ranking who did not wish to remain in the Service should be brought forward for medical when fit to be made F.T. or at the end of five months whichever was the earlier.

Therefore the TB Clinic was established at the Royal Naval Hospital Haslem, and a land rules based registry was initiated in 1955.

Figure 1 shows the decrease in the number of patients recruited in the last ten years — from 362 in 1944 to 27 in 1953. The numbers retained in the last five years are also shown.

It is now five years since the introduction of the long term treatment scheme, and this statement covers the first five year period commencing January 1st 1954 and ending December 31st, 1958. The total number of cases involved in the survey being 262 and includes officers and other ranks of the Royal Navy, Royal Marines and WRNS. It excludes civilians, Army and RAF personnel members of the Commonwealth Navies and Royal Fleet Auxiliary. (Table 1).

Those retained numbered 95 and only those where the decision for retention was made and approved during the five year period have been included. Those evacuated numbered 167 and this figure includes only those whose actual date of leaving came within the 5 year period.

Of the total number of patients (262) in the 5 year survey the method of tracing is interesting. A total of 313 were picked up on routine chest X-ray whilst only 53 (or 16%) were traced for other reasons such as general malaise, chronic cough, pleural effusion, haemoptysis and close contact with an active case. (See Table 1).

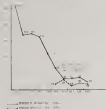


Figure 1

Table 1

(Showing the numbers available and retained each year from 1980-1983 and the totals)

| Year | Retained | Available | Total |
|-----------------------------|-----------|------------|------------|
| 1980 | 17 | 34 | 51 |
| 1981 | 31 | 30 | 61 |
| 1982 | 11 | 34 | 45 |
| 1983 | 20 | 37 | 57 |
| 1984 | 17 | 23 | 40 |
| Totals 1980-1990 | 91 | 168 | 259 |

for entry) cannot be the correct figure, as it is likely that some patients had other ill health (because in the Service as their caregivers concluded). They certainly fit more likely to be accepted as they are more vulnerable patients. The majority of the former patients suggest to make the option of being considered. In all, I think that the ones who do not wish to remain on shore, for 12 months.

The new ones have fallen from 50 in 1959 to 40 in 1963. The number of cases returned in 1960 was 50% of the total but in 1963 the proportion returned had risen to 61.5% of the total cases. The percentage of these returned depends on several factors at the present time:

- (1) Desire to return to the Service with improved conditions and pay (especially senior rates and opportunities under training)
- (2) Change in type of disease — now less extensive and less active and more medical disease
- (3) Ability of the Medical Officer in receiving patients
- (4) Attitude of senior in the majority of cases persuading their husbands to take the opportunity of leaving the Service. 90% of the previously excluded in the five year period were treated last.

The latest two factors and the present practice of giving a patient who is the majority of cases a PRFU with medical clearance the option of going out of the Service if he wishes, greatly accounts for the continued high rate of excluding from the Service. Thus 17.5% of the total of 262 cases in the five year period have been returned. The most gratifying fact is that of those 57 specially selected patients returned, there has not been a single relapse to the present day.

In view of the excellent results of the clinical treatment and the results of treatment generally, it was considered that the time had been reached when the discussion of preliminary observations should not necessarily be considered as conclusive disability. It was decided to follow up the 62.5% of patients excluded over the last five years. An explanatory letter and questionnaire was sent to the Chief Clinician to which each of the 163 patients had been provided for further treatment and follow-up.

The following questions were asked:

- | | |
|---------------------------------------------------------------|-------------------------------------------------------------------------------|
| (1) Date chemotherapy started | |
| (2) Length of treatment | |
| (3) Response to treatment | Complete resolution Partial resolution Unchanged Extension of lesion |
| (4) Was surgery necessary — if so when and results of surgery | |
| (5) Is the patient still under observation? | |
| | (a) Is he still working and if so for how long? |

The response to their exposure has been excellent and gives great credit to the Chest Clinic organization in this country. Sometimes it was necessary to forward the questionnaire three or four times before the patients were traced due to the great changes of address. We received satisfactory replies from 165 initially but no reply following further enquiry or no trace from 2 of these.

SOME STATISTICAL OBSERVATIONS REVEALED BY FOLLOW UP

- (1) Six patients still on treatment
- (2) Only one patient developed extension of the disease in 1968 due to erratic treatment and chemotherapy but now has complete remission
- (3) Following survey and reworking 3 patients underwent surgery. That is 2% of the total all with good results. 17 are late (i.e. 10%) had surgery prior to survey and reworking.
- (4) Only one patient died of the disease six weeks after reworking and this was due to tertiary disease
- (5) One other patient in the series died from coronary thrombosis
- (6) There were six lesions picked up within six months of entry
- (7) Eight local handlers were involved in the first year

As a result of following up all the patients involved during the past five years — all patients could have been removed from the clinical and progress point of view. This statement does not take into account such ratings as 'local handlers' (H) and patients picked up within 15 months of their release date (CD) and lesions within six months of entry (E).

The numbers obtained would be much higher if patients were not offered the option of remaining in the Service or being discharged, which is the present practice (BR, 1759A, Jan 1968 p17).

37.5% of the total of 262 cases in the five year period have been referred. It is for consideration that the time has now been reached when the diagnosis of lesions no longer should not necessarily be considered as involving discharge (10B, 1759A, Jan 1968 p14). Should one compare the diagnosis of discharge alone where there is a high rate of follow up in Category P T E, for at least a year followed by re-lapse and eventual reworking from the Service — no such notion for reworking is given.

On closer analysis of the 165 patients followed up including the six members of the WELPS and officers who six years ago had considerable experience of resistance it has been found that 147 of the total of 165 patients involved could have been removed. That is 17 stages if they had all completed their engagements would have covered a total of 600 years. This makes an average of 3 years 4 months per man. 31 had more than and 65 less than the average period to serve.

These interesting follow ups were traced as follows:

- (1) Shortly after being invalided from the Royal Marine war patrol obtained a full-time civilian job as a Royal Marine Clerk.
- (2) One invalid is working as a Customs Assistant with NAAFI as an Aircraft carrier.
- (3) One invalid is doing some service as one of Her Majesty's Prison.

LENGTH OF CHEMOTHERAPY FOR INVALIDED PATIENTS

Out of 165 patients it was possible to assess the length of treatment for 152 the remaining 13 being accounted for by:

No trace (2) and not known for various reasons (11).

The following table (Table IV) shows that by far the majority of patients (146) had 18 months chemotherapy — (146) had 18 months or less and the remaining (46) came well within the 3 year period — many of these would have length of treatment questioned on the present state of our knowledge.

Table IV

| Up to 12 months | 12 to 17 months | 18 months | 1 year | 2½ years | 3 years |
|-------------------------------------------|-----------------|-----------|---------------------------|----------|---------|
| 6 | 26 | 69 | 50 | 11 | 1 |
| Total 146 had 18 months or less treatment | | | 46 had 2½ years treatment | | |

EMPLOYMENT FOLLOWING INVALIDING

In the 165 questionnaire sent out to the various Civil Clinics, it was asked whether the patient concerned was at full work and if so, for how long? Forty of these there was no trace.

17 were working but it was not known for how long.

2 had died.

1 was in prison.

1 was not working after 18 months chemotherapy and no reason was given.

3 were not working due to 'nervous breakdowns', chronic bronchitis and emphysema, and one help associated with children.

The following are the results of the re-examinations. It should be pointed out that the patients were on full employment from date of receiving and many of the patients were in positions of elevated and stabilisation having prior to the periods given below (Table V).

Table V

| | | |
|----------|----|-----|
| 1 month | 15 | 100 |
| 2 months | 26 | |
| 3 months | 10 | |
| 4 months | 11 | |
| 5 months | 27 | |
| 1 year | 21 | |
| 2 years | 6 | |

Thus 106 were at full work within six months and the remaining 39 within two years.

FOOD HANDLERS

There were 8 food handlers in the total of 105 cases treated. In 1931 further consideration was given to the position of Clark and Stewart. It was decided that no man should be employed in duties which necessitated the handling of food whilst under treatment for pulmonary tuberculosis. In the majority of cases it is not possible for such men to be employed on other duties and they should not be retained. Although in most instances it would be safe there is always the risk that the occasional case might not be. It would be wrong in principle and might detract public opinion should it become widely known. Certainly the applier to Clark but on the other hand Stewart could be employed away from food for six months.

APPENDIX

Of the 105 patients treated 4 were Januars within six months of entry and still under treatment. To summarize:

| Date | Age | Employment | Period treated | Other points of interest |
|-------------|-----|------------|----------------|------------------------------------------------------------------------------|
| 1. 10.31.31 | 35 | 12 years | 4 | Spontaneous rupture (internal) disease |
| 2. 1.1.32 | 37 | 9 years | 6 | Tuberculosis, change with marginal improvement, resolution and dissemination |
| 3. 1.10.32 | 38 | 12 years | 1 | Pneumia Colerae, R.I. Lobe empty. Other a close contact — P.T.B. |
| 4. 1.10.32 | 37 | 9 years | 1 | Pneumia Colerae, R.I. Lobe empty. 2 cases and primary |
| 5. 1.7.33 | 36 | 9 years | 6 | Widespread infection, no delay B.C.G. 4.4.33. Numerous infections |
| 6. 10.10.33 | 38 | 9 years | 4 | Pneumia Colerae — close contact |

On the other hand ten equivalent patients aged between 15-18 were retained (1 with positive syphilis test and 9 with carcinoma in situ). They had served a fully more than ten months but less than one year and completed initial staging. All three were eventually up-graded to Category P-2 following 18 months chemotherapy and 11 with equivalent treatment. Nine of them have relapsed to date.

These facts raise two points. Firstly whether all test-negative under the age of 20 should receive a Mantoux test and if negative BCG vaccination. At first only they contacts were dealt with in this way, but in 1960 it was decided to extend this protection to all new patients under the age of 20 in all establishments. Although several patients in this survey had in fact been converted by BCG vaccination on entry subsequently developing active disease has not made much impact. Secondly the necessity of instituting any of these actions, based on assumed disease should they wish to continue their therapy. They are after all volunteers and may have a highly successful cancer ahead of them.

CLOSER ANALYSIS OF THE RETAINED CASES

The present regime of treatment adopted for these patients retained in the Scheme is as follows:

All patients receive the three primary anti-tuberculous drugs in the first instance, and until sensitivity are retained in these states when the patient is placed on, serologically then Streptomycin is discontinued after three months. Prior to commencing Streptomycin a routine radiograph is obtained. Streptomycin is given daily twice intrapleurally as 1 Gm doses unless over the age of 40 when it is given on alternate days. INAH and PAS are given daily in the form of isopropyl prolamides one tablet containing 100 mgm INAH and 4 Gm PAS twice daily. This preparation has proved to be the most acceptable to the patient and almost completely free from side effects. Isopropyl is continued daily in the majority of cases for 18 months. Occasionally it has been necessary to substitute second line drugs such as rifampicin and diuretics when isopropyl has proved resistant to one or more primary drugs or there has been an increase in deteriorating when hypertension develops.

From the figures before it can be seen that retention is carried out in certain well defined cases, although the numbers have been reduced to about two each year of these retained.

Patients while undergoing therapy are placed in Category P.T.R. this restricts them to three visits in the United Kingdom. At the same time they are required to sign day acceptance contract under agreement and are not allowed to be employed with doctors. They attend hospital for the Patient Interview and Survey at regular intervals.

The details of these selected risk years are as follows:

| | | | |
|------|-----------------------|----|------------------|
| 1979 | Mild/mod disease | 14 | Total = 17 cases |
| | More advanced disease | 3 | |
| | Positive sputum | 3 | |
| | Surgery | 4 | |
| 1980 | Mild/mod disease | 24 | Total = 34 cases |
| | More advanced disease | 3 | |
| | Positive sputum | 6 | |
| | Surgery | 7 | |
| 1981 | Mild/mod disease | 11 | Total = 12 cases |
| | More advanced disease | 1 | |
| | Positive sputum | 1 | |
| | Surgery | 1 | |
| 1982 | Mild/mod disease | 18 | Total = 26 cases |
| | More advanced disease | 2 | |
| | Positive sputum | 3 | |
| | Surgery | 2 | |
| 1983 | Mild/mod disease | 15 | Total = 17 cases |
| | More advanced disease | 2 | |
| | Positive sputum | 1 | |
| | Surgery | 2 | |

Thus it can be seen that surgery was carried out on 16 patients in the 5 year out of a total of 92. This is equivalent to 11.5% of those assessed.

Surgery was carried out on 17 patients prior to survey and consisting, which is 10%, of the total assessed. After survey and instituting a further 8 heat surgery which is 5% of the total. There was a positive sputum in 18 which equals 11.5% of those assessed. Only 11% of the assessed patients had more advanced disease whereas the majority i.e. 89% had only mild/mod disease.

ADVANTAGES OF SERVICE MANAGEMENT OVER CHEST CLINICS

Modern chemotherapy depends mainly on the long term co-operation of the patient. In the service we have the great advantage: the patient continuing treatment in hospital, he then returns under close supervision to an out patient unit under service supervision. Spot checks on the serum for FAN on all out patients in the past two years have been consistently positive confirming that the patients have been taking their drugs. (Chest Clinic report figures in low to 24% for males and 36% for females and showing that chest patients do not take the drugs prescribed) (Pope and Stirling, 1986).

that it is not safe to stop drugs in the majority of cases, and unless an alternative to the suspension of the chemotherapeutic agents is available in 18 months to 2 years chemotherapy is considered adequate in the majority of patients.

Advantages of the pattern of hospital visits are self-evident in the Service and the patients no problem (1) for isolation, while there is the possibility of infectivity (2). To undertake their chemotherapy (3). For evidence of drug hypersensitivity early in treatment and (4) for the occasional patient with more severe disease and constitutional disturbance.

ROUTINE ANNUAL X RAYS

Since 1941 every officer and sailing ship's doctor undergo an annual radiographic examination of his chest as first with a 15 mm film and since 1958 with a 70 mm film. Each completed case has previous films reconstructed and is, if admitted to hospital for an extensive clinical, radiological and laboratory examination. A decision is then made regarding his diagnosis, treatment and disposal. 80% of the 162 patients in the five-year period were picked up in this way.

In the past year 1964 it has been observed that of a total of 17 patients, 16 were found to be out of date on their annual X rays on being picked up. The periods out of date ranged from 3 months to 5 years — two cases with positive sputum, two with positive cultures and 12 not bacteriologically positive. Forty-sixty more of the 4 positive cases were serving in age when picked up.

This observation underlines the absolute necessity for maintenance of routine annual chest X rays in the Royal Navy and emphasizes the need to keep these in date. It was decided to find out how many patients in the five year survey were out of date in their annual chest X ray. The number is considerable and ranges from one month to 5½ years.

Table VI

| Year | Out of Date | Positive Sputum | Serving Afloat with Positive Sputum |
|------|-------------|-----------------|-------------------------------------|
| 1958 | 47.5% | 6 | 3 |
| 1959 | 40% | 9 | 3 |
| 1961 | 36% | 1 | 1 |
| 1962 | 44% | 6 | 3 |
| 1964 | 62.5% | 3 | 1 |

Brooks (1957) in his *Mass Chest X-ray* pointed out that the MMR made possible by the work of D. Addison (1936) had been widely adopted throughout the world as the least costly procedure for finding otherwise unsuspected cases of pulmonary tuberculosis in various population groups. Brooks pointed out that it gives a much more accurate picture of the prevalence of the disease than any other method. In epidemiological value may be illustrated by some experience on the Royal Navy, where it was first used and developed in this country—largely through the efforts of Dr. Sir Herbert Guthrie — and where it has become an annual event for many years. The most important and widely understood index of the consequences of repeated fluorography upon the incidence of pulmonary tuberculosis in the Royal Navy was to be found in the marked rise of the disease in those established personnel previously found to be normal by fluorography. This is measured by the aggregate of the incidence of new cases detected by fluorography and of new cases diagnosed through the disease becoming clinically evident. The figure had been shown by Guthrie (1950) to have remained fairly constant at 2 per thousand per annum for many years before the war.

It had fallen (Brooks and Fraser Roberts) by 1945 to 1.1 per thousand and in 1955 to 0.54 per thousand. In the last five years it is negligible.

The fall seemed to be related to the corresponding decrease in intervals between examinations. Brooks felt that taken in conjunction with the fall in incidence of clinically-detected disease it seemed probable that if annual fluorography was discontinued pulmonary tuberculosis following admission within the Royal Navy would be controlled and kept at a minimum level. For this reason, no similar vital other trained elements of the community were fit, as in the Navy are continuing with the routine annual chest x-ray radiograph in view of the special conditions of Service. From the above figures over the past five years (see Table VI) from 16% to 42.5% of new patients each year lay out of duty with their clinical X-rays. More important from 1/5 of these have positive spurs each year of which from one to three with positive spurs were actually serving at sea in one of Her Majesty's Ships. In 1958 at a combined Service meeting with the Ministry of Health the necessity for annual X-rays in the Royal Navy was questioned by the Ministry of Health and a motion that annual X-rays in the Army was suggested as an alternative. It is felt that the above figures emphasize not only the necessity to X-ray the entire ~~community~~ but to ensure that this is carried out.

SUMMARY

This survey it is hoped has shown that the majority of patients found to have pulmonary tuberculosis in the Service could well be returned to complete their engagements with but a series of valuable personnel and expense of individual imaging.

The exceptions would be those personnel with only 18 months to 2 years to complete their engagements and possibly Clerks. The regulations have recently been

right and counseling the rules of consultation with a physician prior to initiation of treatment. The issue has now arisen when a patient asked again the Royal Free Unit Pulmonary Tuberculosis should not be given the option of attending at the surgery or appointment for interview, but that such cases be consulted on an individual basis.

As a radically unmet population posing a serious health risk, as a rapidly increasing risk of becoming primarily individuals, all these conditions posing under the age of 20 years should be diagnosed or treated. Appropriate actions should be given. Early examination and strong recovery (either chest radiograph or three months). This together with a strict annual X-ray will bring the likelihood of outcome but cannot eliminate and control even better control.

The findings on follow-up of the 110 patients matched between 1979 and 1981 and the first half of the patients treated over the past six years (the no more with only measured disease) who have been upstaged to P2, have served to clarify and support clinicians and to show them the not-very-one single relapse, both support a more modern method on continuous intravenous control and on the blood flow.

[illegible]

- It is worth to mention, however, that in a recent work by Falcó and Falcó (2007) the performance of various data sources after the 2004 tsunami has been analyzed, and the authors conclude that the information from the geophysical observations, together with the findings of the United Nations or World Health Organization, is likely to be helpful in keeping the records on earthquakes and on the associated risk up-to-date.

Abstract

- DE VRIES, M. 1970. *Rev. and Perspect. J. L. 29*.
 LAMBERT, R. M. 1960. *J. R. Soc. Med. 54: 39*.
 MONTGOMERY, D. W. 1973. *Am. J. Hyg. 97: 541*.
 PETER, C. and WILSON, R. 1970. *J. Hyg. 65: 1*.

| Age Group | No (%) | Yes (%) | Don't know (%) |
|-----------|--------|---------|----------------|
| 18-24 | ~15 | ~45 | ~40 |
| 25-34 | ~10 | ~55 | ~35 |
| 35-44 | ~10 | ~50 | ~40 |
| 45-54 | ~10 | ~45 | ~45 |
| 55-64 | ~10 | ~40 | ~50 |
| 65+ | ~10 | ~35 | ~55 |

Question: How often do patients with long-term use of these agents get their blood pressure checked from the time they start taking it?

Surgeon General **BARRY WILKINSON:** There are two points I would like to clear up quite quickly. Why do we put them in the center of going out? Part of all we say that with the majority of cases typical of the flu virus it is only fair to give the chance of going out. More important too is to consider the immunosuppressed patient with whom we have had little success. I think the figures will show that that was justified. I suggest the position might be the same in such Occident Union, they might get better results if they go to them the option of going out. The other thing is the fact that where you can employ a Surgeon Captain, which it is more difficult to employ a young male nurse, for two or three years after he has been picked up and there is nothing worse than the young young thinking his health is threatened for 10 months to two years. That is why some patients are not motivated.

Surgeon Captain P. C. SELLER: I think there is one factor here for the reduction of the tuberculosis problem and that is the increased tightness of ships. I think you will remember quite a few years ago when we used to retire some people on full duty they came back from ships with cavities. It didn't seem to work very well. Now with air conditioning in the modern ships which means increased comfort, I think that these natural built-in advantages make living conditions much

Table 1
Pulmonary Tuberculosis (Annual Rate/1 000) in the Royal Navy

| Year | Officers | Livingage (Range) | Seelags | Livingage (Range) |
|------|----------|-------------------|---------|-------------------|
| 1955 | 0.3 | (14,700) | 2.5 | (128,800) |
| 1956 | 0.9 | (14,700) | 2.9 | (112,800) |
| 1957 | 0.1 | (14,700) | 1.5 | (108,870) |
| 1958 | 0.5 | (12,800) | 1.4 | (100,800) |
| 1959 | 0.4 | (12,800) | 1.4 | (97,420) |
| 1960 | 0.7 | (12,800) | 1.1 | (98,600) |
| 1961 | 0.6 | (11,300) | 0.4 | (98,150) |
| 1962 | 0.7 | (10,890) | 0.8 | (93,000) |
| 1963 | 0.7 | (10,700) | 0.6 | (91,200) |
| 1964 | 0.5 | (10,700) | 0.6 | (91,200) |
| 1965 | 0.5 | (10,675) | 0.7 | (90,550) |
| 1966 | 0.5 | (10,640) | 0.5 | (81,845) |

better and I think these men are responding. The modern ships in the tropical areas are not because of air conditioning and the men suffering from the double duty seem to do much better and I think that is quite a big factor of good prognosis.

Surgeon Captain P. P. SELLER: Professor Donald asked about the rates, his tuberculosis in the Navy earlier today. I received figures from the Ministry's Statistical Department this week which show the annual rates for officers and men for the years 1955 to 1965. (See Table 1)

The average strength of the officers is approximately one tenth that for the men. If you look at the rates per 1 000 for example, you will see how the rates have fallen from 2.5 per thousand in 1955 to 0.5 in 1966.

Now you will recall, Mr. Chairman, I think you referred to it as your *Black Diamond* lecture that as Sir Melville Doolby pointed out, the incidence of tuberculosis in the Navy was once as high as in the other Services, and had been so since

the men of the Services was cut in half when the Second World War started. In 1955 this was still largely the case. Now, in 1963, we reach a figure which is comparable with those in the other Services. I have not the figures for the Army and Royal Air Force for 1963, but I have for 1962. In 1962 for the Royal Air Force the rate was 0.07 per thousand and for the Army 0.7 per thousand. So it would seem that this difference has now been largely closed and another improvement is seen in this Table for New Entries with pulmonary tuberculosis.

Table II
Pulmonary Tuberculosis—New Entries

| | New Entry Entries | | |
|------------------------------|-------------------|-------------|-------------|
| | Under 12 | 12-1 yr | 1-2 yr |
| 1955 (total ratings 129,000) | | | |
| Rate/1000 (new) | 4.4 (26) | 2.5 (46) | 1.9 (16) |
| 1962 (total ratings 11,765) | | | |
| Rate/1000 (new) | 0.73 (1) | 6.8 (9) | 0.91 (5) |

Chairman: Were there "stroking" or "pick up" rates?

Reply: Total new entries.

This table shows the rates for new entries picked up with pulmonary tuberculosis under 12 months on the Navy—then, from six months to one year and then between the first and second year. The rate per thousand in 1955 for the first six months was 4.4/1000; by 1962 only one man was picked up during the first six months of service, a rate of 0.029. In the second six months of service in 1962 no cases were "picked up" although in 1955 46 cases were "picked up". However, between the first and second year in 1962, 9.9 cases were "picked up" but there had been 16 cases "picked up" ten years earlier. During the last 2 years up to 1955 there were 88 new cases of pulmonary tuberculosis in new entries; during the same period up to 1962 there were only 6.

On a different topic: I would like to ask what should we do with the ratings who react very strongly to the Mustina test on joining? I am thinking of a surgeon which is more than 10 times as common. The first 1962 survey showed that percent with a reaction of less than 10 was more prone to tubercle and that one in twenty of the strong reactors did break down later on. Is there any justification for using the Mustina test on a man who has just joined the Service as a youngster, so is screening him? If he has a one in twenty chance of developing tuberculosis, is that a risk the Navy can accept?

The other point I would like to make concerns the financial deficit that in the annual claim X-ray. Is it not true that we adopted a similar approach to the problem as the Army did with medicine during the Second World War and make it the executive responsibility to see that every man in the Service has an annual claim X-ray? The Medical Branch cannot control this as it should. We have not the authority we need. The Enclave Branch has? We must still do all we can not only to protect the individual but also to stop the individual from seeking his remedy.

Sergeant Commander CLIFF: In Commander Usher's more extended paper a great deal of attention was paid to the question of extending the interval of X-ray to every three years though in the Ministry of Health the reasons to extend the period are very strong and said that we could not extend it. We still want to keep an interval that if we can. If we come to the deficit rate it is largely an insurance responsibility as they are responsible for the new dealing regulations which enable a sailor who has come back from the front line to spend 12 weeks in 7 months, leave and then go straight to his next assignment. He doesn't go through a waiting period as barracks to enable not to wear him before going to his new job as he must do and this was inevitable from our point of view because his chest was X-rayed and he could not get in or out of the gate without his chest being X-rayed again. If he happened to have two drains a year but X-ray was done twice if he had three drains he was done three times. Now if a man has been to my flying camp for 2½ years with his family he cannot come and has two drains, leave and the X-ray on deck and means one filter along there. I think that is the very reason for the deficit rate.

Chairman Doctor BROOKES: There is going on and I have a story to relate at the time. When mass radiography was first introduced to the Navy there were real problems with the cameras for maintaining in training. Now this was in 1941 but I will remember going to a bunch of Admiralty House in Chatham with the Commander in Chief the Senior Officer responsible for training, Churchill and William Dudley. Dudley said to Winston Churchill the object of my being here is to try and persuade everyone that it is a good thing to cut across training and at one below the stage we can see that the personnel have an X-ray. Churchill won the day by turning to the Commander in Chief and saying: You know you would bring us back to the days of Nelson when the Navy was full of Syphilis victims and the fact was that there were no other symptoms?

THE CHANGING PATTERN OF TROPICAL MEDICINE in the Royal Naval Hospital, Plymouth

By Surgeon Commander P. J. Fenton, RN

The Royal Naval Hospital in Plymouth is a general hospital with an admission rate of some 34,000 patients a year, seventy per cent of which are patients from the three Services, among which are included 12.15 per cent of Royal Marines. In addition we have some 70 per cent National Health Service patients referred by their family doctors in the usual way.

It is my purpose to discuss the general changes in the sort of tropical diseases seen in this hospital since 1962 and as time is short, I have restricted myself to primary diseases. Secondly, since the majority of the population which we serve is always shifting, with the movements of ship, regiment and command, figures of incidence have little meaning and this discussion will therefore be concerned towards illustrating the type of cases we see, under three main headings:

- 1 Civilian
- 2 Soldiers and Royal Marines
- 3 Sailors

Considering the civilian first, it must be remembered that the west country has been a good recruiting area for all three Services and therefore many of our civilian patients have seen foreign service. Hence our primary disease is therefore not rare and can be illustrated by two cases.

Case 1. A 76 year old man referred by his general practitioner for squamous carcinoma of esophagus during the past three years. Having lived in India for 20 years he moved to this country. No abnormal neurological signs were found and the civilian country system was remarkably good for his age. No marked lymphoid, W.P. 126/70 W. B. S. Kahn negative, C.F.P. normal. Self-exam. & spec. revealed many enlarged glands in upper areas unencapsulated and necrotic.

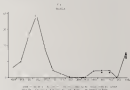
Case 2. A 24 year old woman who presented with a symmetrical symphorically. Rheumatoid-like rheumatism a large enlarged eye and there was an area of calcification in the lower left arm a study of having been brought up on a ship born in India where some when she last spent (over two years in India) lived only in urban surroundings in military hospital. She had had no day work since arrival at the age of 20. The Central anastomosis was negative but the isolated conjunctival tarsus was well preserved. Sphincteromy was performed by Surgeon Captain MacMahon and the right eyeball a calcified dead behind eye.

Such cases therefore illustrate the pattern of tropical disease amongst the civilian population.

Before considering the Service patients, two points should be mentioned. Firstly, all patients transferred from abroad go to the Royal Naval Hospital, Hather and therefore those mentioned here have not been specially selected by being taken off on tropical service, but have arrived during the course of the normal pattern of the

hospital. Severely, members of League Services in England for growing have been excluded but people of demonstrable origin among under the Crown have been included. The latter are present problems.

Case 2. A 40-year-old female Chinese joined the Army three years ago. In was diagnosed as B. G. Malignant Myocarditis with a coronary artery disease which by now found to have a 14 per cent stenosis and a heavy calcification with stenosis of the coronary artery. The information by the Chinese doctor of the 'New World' is reported as being completely non-progressive but it was noted that the last long-term diagnosis in the past part of both myocarditis which had been present for some years. There were data that by an 'Osteoblast' calcification in different lymph channels and one was reported the myocarditis being reported as being progressive and this being a clinical lymph channel of one end of the artery. One wonders whether this had any relationship to the third calcification.



Turning to the Service cases proper, Figure 1 shows the number of cases of Malaria that have occurred in the hospital in recent years. The peak incidence was in 1951 and all three cases were relapses of benign tertian malaria in Royal Marines who had been serving in the Commonwealth Brigade in Korea when they had been taking suppressive drugs during a time when they were fighting in what one might call a typical infantry rather than a Commando role. There is a further slight rise in the cases of benign tertian malaria in 1956, some cases being contracted in Malaya and some possibly in Tripoli, followed by a more marked rise in 1959 due largely to Royal Marines returned from Aden, E. Africa and Indonesia in 1964. In 1964 the data indicate the cases of malignant malaria and as there are the most dangerous type for the military clinician it is worth mentioning these under of prevention. Two presented with gradually increasing fever rigor and headache in the usual way and was referred to a medical out-patient for investigations, two of a mild nature. The fourth case would have been noted had a history of the movements not been taken.

Case 4. This 33 year old Royal Marine had been suffering from vague foot numbness, pain, and tingling for about three years when he was recruited by his unit and sent to the island. He denied any form of injury but admitted that he had sustained some ill effects some years earlier before. He appeared to be fully slightly rigid and there was a suggestion of a mild tremor, as he spoke and. A blood test showed the presence of Phosphatase alkaline, high and it was not until he had been given Chloroquin that he had cleared and he experienced the expected feeling of burning along the proximal nerves.

In discussing the tropical diseases contracted by Servicemen, one must draw attention to certain differences between the habits of sailors on the one hand and Royal Marines, or soldiers on the other. Superficially one would assume that would make service in the Royal Navy would result in a high level of endemic disease. This is not so largely I believe because ships at sea are hygienically supervised closed units, and of contact with parasites and insect vectors. Even when they go ashore sailors seldom go further than walking to the main deckhouse from their ship. They therefore tend to remain in more or less sterile surroundings. The Royal Marine on the other hand no longer lives on a main deck of a ship group where with the water his role has changed so that Private Orderson's definition of a Royal Marine being, a kind of gully or intermediate-soldier, but whilst one is no longer appropriate. Now the Royal Marine is landed from sea, or air, participating inland regularly, often in small units and sometimes for some time as a spear head soldier in contact with the local people, resources and insect vectors.

In other words where sailors may contract one kind disease such as malaria, which once introduced is capable of proliferating within the host to a sufficient parasite level to cause disease, they do not contract such disorders as Phlegmas that require repeated infection to achieve a sufficient parasite load to cause disease.

Fig. 2



Figure 2 shows the number of cases of Phlegmas seen during the period in question. All were Royal Marines or soldiers and a Phlegmatoma, only in that of Case 5.

Case 5. A 24 year old Officer from the Royal Signals Regiment was affected as he was with a fairly full superficial information as to the state of the island. The total length of the symptoms was some 17. He had had two similar episodes during the preceding year. All three attacks had been accompanied by slight discomfort in the exposed joints and began within 48 hours of these days.

He had a history of 10 which started in an injury and general examination was otherwise normal. The history of two movements revealed that two and a half years before he had gone to Malaya and for a short time he had been employed looking for the people to place as possible, in order to accompany to villages, often for three or four days and nights on and

while reporting to an appropriate medical appointment. After this study was obtained a comparison between the number of 100% cases of 3/50s was obtained and prolonged results of abnormal results reported on previous of "angiograms" at 30-60 seconds. No reported result in (angiograms) was (not) recorded on further episodes of "angiograms" during a given study (or) follow up.



It is perhaps worth noting that two cases of Warmer presented with a hydrocele and slight macropneumia.

Figure 2 shows the cases of amnesia during the period in question and remembering that the total number of water patients far exceeds the total numbers of Royal Marines or soldiers the great preponderance of military cases tells the same story namely that the water has less risk of contracting peritonitis disease.

From the clinical tale there were only two points of particular interest in this series of cases of amnesia. Firstly there were four cases with amnesia of the liver all were typical in their radiological presentation with tearing of the right diaphragm. It is interesting to note a feature that has often been pointed out before, namely that all these four cases developed in Royal Marines during a time when they were employed on a diversion and rehearsing military exercise. Secondly if not heard is most the physical requirements for service in the Royal Marines, electrocardiogram changes such as those illustrated in Figure 4 are a matter for some concern. Since starting to replace lithium hydrochloride on treatment with (Diuretic) medicine we have had no significant electrocardiogram changes but this may only be a tentative conclusion as the work is at present incomplete.

As the last two years experience in Plymouth have suggested that the Royal Marines had at present a higher incidence of patients desert than any of our other patients it was decided to do a series of mood examinations on Royal Marines with no complaints arranged on a voluntary basis. With the assistance of Surgeon Captain Lamb and Surgeon Lieutenant Nicholson these examinations were obtained from all Commanders. This work is at present incomplete and is therefore only mentioned briefly in passing. The results are recorded in Figure 5.

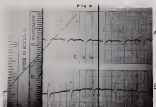


FIGURE 1

| A) <i>Thapsia</i> Salix | | B) Royal Marine | P (Eq. 10) |
|-------------------------|-----------------------------------|-----------------|------------|
| — | E. leucodonta (borns. and change) | | 3 |
| 1 | B. leucodonta (spits) | | 11 |
| — | Trochura trochura | | 3 |
| 4 | Araucaria | | 8 |
| — | Asplenium (m) | | 1 |
| — | Stenopeltis (borns) | | 4 |
| 2 | Quercus (spits) | | 17 |

Without saying more at this stage it is clear that these figures give some support for the belief that Royal Marines are at greater hazard from periodic drought than sailors.

In 1944 Surgeon Commander Broughton reported to the Admiralty some cases of dental Leishmaniasis developing in Royal Marines in the Red Sea valley in Aden. During the war that several Leishmaniasis is not reported in Aden the following case history is interesting.

Case 1. This 20 year old Royal Marine had been in the Red Sea valley some months before when he was heavily bitten by various, presumably sandflies while deserting on shore and off-shore. The infection was observed first, a lump for when he was returned to hospital with a swelling (over and round) he was at first confused with a severe headache and could not see how long he had been ill. He had a splenomegaly and there were many tiny foci of malignant vesicular lesions in the nasal film. Treatment of the disease

his small intestine but did not allow his liver to be changed in its shape. Within a few days his white cell count fell to 1,000/mm. with 50 per cent mononuclear cells. The lower extremities of his legs in short a fibrillar patch in the lower half have perished and the spleen continued to enlarge. At this stage the white effluents began to fall and the globulin in serum a positive Fernald gel test developed. Subsequently the diagnosis of "Hemeral Larch" was sustained by serological, histological, bacteriological studies in various tissues and the patient responded well to Potassium.

Once again such a case demonstrates that the unexpected must be sought for in particularly soldiers and Royal Marines returned from abroad.

There are also reasons when Service factors alter the pattern of a disease and have an influence on the natural history of a parasitic disease.

Case 7. A 30 year old Royal Marine had a chest about 5 cm in Singapore and before he entering his lungs. After two weeks periods he developed a low grade mononuclear and he was transferred to Singapore where he was found to have an erythrocyte of 17 per cent the white globulin percentage had advanced to 50 per cent when he made a spontaneous recovery after about 5 cm in this case showed intense focal granulocytic clusters of a typical distribution but the first third of the period he continued to have. During each of which occurred in his case very complicated. Each episode of convulsion was followed within a few days of the onset, by an exacerbation of his condition. He returned to England at the end of his term of duty and he began an attempt to a cold climate to benefit respiratory system. This episode was followed by a clinical attack of bronchitis during which he was admitted to St. Vincent's Hospital.

Chest examination was but no significant abnormalities were detected during his visit being fully with the modification of about six weeks of mononuclear phagocytes in the lung. The phagocyte percentage changed 50 per cent mononuclear and 11,000 white cells per mm. in the third he had 50 per cent mononuclear. The chest X-ray showed considerable enlarged focal pleural thickening, a very small pleural effusion at both bases and signs of dilated granulocytic clusters in both lower zones. The third examination showed no signs of granulocytic clusters was negative. The third showed large numbers of granulocytic clusters, some also larvae. After treatment with Potassium there was spontaneous improvement, disappearance of the enlarged chest, cure for the persistence of pleural thickening and a return to normal mononuclear levels in the blood.

The interesting feature here is that *Strongyloides stercoralis* naturally reproduces normally in the gut wall and being discharged which have returned their contracted larvae by the time the faeces are passed. These larvae are really mature in shape warm and into the potentially infected stage they are themselves capable of penetrating directly or through faecal soil under certain circumstances. The larvae can also within a contracted state in soil and can mature in the returned faeces to the recovery stage in which case the original host is re-infected by mature larvae penetrating the gut wall, whether they travel to the lungs and maturing may occur in the lungs. In this manner a massive infestation can be built up. That this cycle occurred in the above patient is reasonably proved by the finding of what are definite and short lived *Strongyloides* eggs in the sputum. Thus a mature infection which resulted in impairment of pulmonary ventilation obtained systematically was built up partly owing to the compensating effect of compensatory.

These then are illustrations of the sort of diseases that may be caught by Royal Marines and soldiers. Just to preserve a sense of balance, if sailors are limited

either as a military parcel or being absent so if they are personally adventurous and venture away from urban surroundings in the tropics, they too can develop schistosomiasis.

Case 8. An 18 year old soldier came on a leave pass to St. Louis where there were no snail-free dogs about that month of that decade was bitten by three proboscis which the party was holding. The following day he had a tingling sensation at the sites of the bites, low back, shoulders and right knee. A week later he developed a pruritic-vesicular eruption at these sites. This only passed and after a further two days began to die away being replaced by the appearance of thin red round macropapular lesions which continued to progress through the skin at various sites for the next few weeks. There were the marks of the larvae of the dog hookworms of common variety which were taken out. He was given *Diethylcarbamazine*.

Such a condition is, however, rare in the order and far more likely to be found in the order of Royal Marines.

Now that the Royal Naval Medical Service is responsible directly or indirectly for the many of fighting services at sea, on the air and on land, it behooves us all to remember the remarks of that gentle physician Sir Tom Browne who wrote in a letter in 1890 saying: "New discoveries of earth discover new diseases, for beside the common vices there are endemic and local interesting proper only certain regions which on the whole earth make no small number, as... of Asia, Africa and America being no less but Pandora's box would swell and there must be a strange pathology!"

ENDING NOTES

1. *Immunus* (London: Author in 1961) 100.

2. *British Medical Journal* (1964) 1: 174-175.

3. Thomas Browne (1606) Letter to a Friend upon the occasion of the death of his nephew James.

Discussion Following Paper

Comment: I just wanted to say that I received advice some time ago of electrocardiograph changes suggesting that a serious myocardial infarct was not so far due to manifest.

Sergeant Commander PRESTON: I have not seen any myocardial infarct only in China, the fact is known to be particularly common, but I feel that whether any ECG change I represented is a true myocardial or not is really of very little importance when I am talking about a Royal Marine who may be expected within the next 6 months, to go 30 miles in some 11 hours. I think it is probably true that most people in that order do great durability from having a course of exercise but I am in my particular role have concerned with people who must be potential super athletes.

Sergeant Commander J. CLIFF: I think, Sir, it is that a particular feature of tachycardia that these patients develop. I am more impressed with that than an excessive dose of exercise or of an extremely course. You sometimes see them

coming back from abroad where clinical trials of effluents have been carried out and there is pronounced tachycardia which possibly denotes work for a matter of months.

Doctor WALTERS (Hospital for Tropical Diseases). We have had one more melanotic episode with a green erythema after using the linear drug (Dihydrocinchon). In the case of this patient, he had had 40 mgm daily for 10 days, perhaps a little less, and was given a sixth 4 days after it daily exposures and then completed the period. May I ask with regard to the photograph of the eye of the man from French Guiana — they wouldn't happen to be float spots would they? Because most everybody has float spots, float spots is a condition very common in the West Indies and even the conjunctiva has undergone this change it rarely returns to normal. This might be a possible diagnosis unless it is a tumor.

As regards Kala our men who had been serving in the Arabian mountains this is a fascinating discussion of what time up when people look for it in an area which has previously never been explored. I found two cases of Kala near the Persian Gulf area, one of whom came from the Arabian side of the Gulf and it would seem that in very rare instances Kala can also occur in that area.

Surgeon Commander FROSTON. I am most grateful for Doctor Walter's comments on this. May I take them in their parts the first being the evidence. This patient, in fact, was deliberately treated for 10 days. I was well aware of the recent two reports on Dihydrocinchon producing toxic changes. If I may lead back to what I have said, I have not since HCB in my mind seen any significant change. I am in the process, in fact, of sorting out those. Perhaps it will be the drug of choice, it may be, I don't know.

Secondly the question of float spots. In this case I asked my ophthalmic colleagues not only to see him when they said there are float spots (perhaps the most for floaters) but they also did the biopsy which showed an apparatus which I do not think corresponds with float spots though I would hesitate to say what the histology of float spots is, off the cuff.

The Redfin Kala case is in fact a fascinating story because the young man was employed handling down excavated Arab villages in the Redfin valley. He, and his chums used that they had a terrible time being bitten by "sodges" which I assume are the sand fly. Now I have asked three Royal Marines, many of them, what they saw in the Redfin valley with regard to animal life. Some of them have described parasites to me — they have all talked about dogs, but as far as the *Yersinia* *Leishmaniasis* goes I cannot help feeling there was a doubtful Arab carrying the disease from somewhere who was living in that village at the time or just before and probably infected the Redfin.

Chairman Doctor BRIDGES. Thank you very much Surgeon Commander Frost for your most interesting talk.

NOTES

Wargers

Chairman: Sir Cecil Walsley, B. Sc., F.R.C.S.

THE PATTERN OF UROLITHIASIS IN THE ROYAL NAVY

By Surgeon Commander N. J. Blacklock, R.N.

Epidemiological surveys of urolithiasis are already recorded in medical literature, and these examine various aspects of the disease. Most however apply to civilian populations. These appear to have the shortcoming, certainly in respect of the assessment of the overall incidence of urolithiasis within a community, of considering only those cases who have been subjected to surgery. There is therefore a possibility that these surveys do not reflect the true incidence of the condition in their various population groups. In the Navy on the other hand such are the implications of a urinary calculus in Service life that all cases of suspect cases are subjected for full investigation and have therefore come under scrutiny in the review of 358 cases of proven urolithiasis.

In this survey a survey has been carried out of all the cases listed in the Medical Records Department of the Navy as having had a urinary calculus in the seven year period 1958 through 1964. For the purposes of this survey only those cases in which a calculus was demonstrated by x-ray or subsequently removed have been considered. The survey therefore represents with reasonable accuracy the overall incidence of confirmed urolithiasis in naval personnel during this seven year period. The limitations implicit in this survey are those inherent in any Service disease survey: there are a selective age range and in some cases a follow up limited to a few years when an individual has left the Service (the criticism commonly directed at an epidemiological survey within the Services—that it is carried out in a community of fit people—is in this instance decreased as it would appear that in the age groups under consideration, primary urolithiasis occurs as frequently in the relatively fit as it does in the community at large).

General Incidence

The overall incidence of urolithiasis in naval personnel was found to be 0.43 per thousand. In comparison the Swedish National average was found to be 0.6 per thousand (Blomberg, 1951); for the same average age as the Naval survey, that mentioned for Finland (Sallinen 1959) was 0.57 per thousand. By comparison the American National average was 0.94 per thousand (Geyer, 1954) so that again this figure appears high but it does of course represent the incidence in a general population with no age restrictions as in the Naval survey where the

dent and fourth dentists are predominant in respect of this it has been shown that the highest incidence of unfitness occurs in the 18th decade of life (Ballman 1959, Warshaw 1972, Finch 1959, Lerner and Philip 1962).

Incidence Relative to Occupation

The Navy presents a factor of interest in relation to unfitness which is perhaps not shared to the same extent by the Army or the Royal Air Force. This is the variation in environmental temperature experienced by personnel according to their occupation. In this respect, men working on a closed ship's galley and engine room personnel are exposed to much higher ambient temperatures than the remainder of the ship's company. With the so-called 'hot weather strain' as accepted entity as regards the greater tendency to unfitness in the tropics, it was felt desirable to examine whether there might be a similar entity amongst those permanently employed in hot environmental conditions and

Table 1

| <i>Occupational Groups</i> | <i>Incidence/1000</i> |
|------------------------------------------------------------------------------------------------------------|-----------------------|
| Seamen Naval Artisan Explosive Branch Communications Branch Ships' (ft) Artillery Submarine | 0.27 |
| Electrical Artisans Electrical Mechanisms Electrical Mechanics | 0.25 |
| Royal Marine Corps | 0.26 |
| Wipers Stewards Deck (ft) Branch Storekeepers | 0.26 |
| Cooks | 0.29 |
| Forward Room Artillery Mechanisms Mechanics (F) | 0.41 |
| R. R. N. S. Naval Training Artisans Q. A. R. N. S. | 0.29 |
| Officers | 0.07 |

responsible by virtue of a significantly increased incidence of serious sickness amongst these occupational groups. In pursuing this line of investigation all naval personnel were disposed in groups having roughly comparable working conditions. These are set out in Table 1 and the incidence of sickness per personnel of each of these groups has been determined.

In the four occupations with high environmental temperatures—the engine-room, and motor-room—it was found that the incidence was about one and a half times the average incidence of the other occupational groups excluding the officers. It would therefore appear that these occupations within the Navy do in fact carry an increased risk of sickness. A relatively high rate of occurrence was also found in the group consisting of seamen, stewards and sick berth staff since a considerable amount of the work done by personnel within this group is voluntary. The question arises whether this may not be one of the sociological factors involved in this instance.

The high incidence amongst officers is incidence even greater than that of the engine-room and motor-room. This finding is not however a new one and a review of the literature reveals that Millett and Gault (1945) who carried out a survey of sickness within the United States Army found that the incidence amongst officers was two and a half times greater than in the other ranks. Similarly Koller (1947) in a paper on upper extremity tract sickness in the United States Air Force noted eight cases of arthritis in 400 flying personnel whilst there were no cases in 400 ground staff; these figures however have to be considered with the reservation as Koller himself points out that the ground staff comprise a fairly high proportion of negroes who as a race are well known to have a relative immunity to primary urinary infection (Rogers, Garvey, Stevenson and Watson Salton 1955, Correll 1947). It is perhaps relevant in the present context to draw attention to a survey by Larsen and Flisby (1943) in Denmark into the incidence of arthritis amongst the Danish medical profession; this enquiry was carried out by means of a questionnaire to which nearly 1,000 of the doctors replied from this it would appear that over a five year period 4.6 per cent of these doctors had had symptoms of arthritis; furthermore 5 per cent had been admitted to hospital with the disease. By comparison with other general surveys this is a high rate of incidence in this professional group. Consideration of all the foregoing leads us to conclude that though the primary sicknesses like coronary thrombosis might have predominant sociological causes. In this respect it will be of interest whether the relatively high incidence in officers is repeated in a future survey.

Sickness in Engagers

In the investigation of the relative incidence of sickness within the various occupational groups which has just been considered a feature appears as early as that the number of engine room personnel affected was not comparable as between the early and later years of the survey.

Table 2

| 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 |
|------|------|------|------|------|------|------|
| 0.7 | 0.4 | 0.15 | 0.61 | 0.58 | 0.51 | 0.42 |

Incidence 1000

From Table 2 it can be seen that there has been a fairly steady and significant decline in the incidence of sensory ulcers in engine rooms personnel between 1958 and 1964. The implications of this have been considered and, since there has been no marked change in the temperature of the engine and boiler room spaces during this time it is felt that it must probably represent the effect of the increasing use of air conditioning in ships. The incidence of this will undoubtedly have been relatively greater in the more dark, air engine room personnel since these are adjacent to the engine room spaces and prior to air conditioning, tended to be quite markedly affected by 'sweat heat'.

Climate and Unstinkness

Others have recorded their observations on the increased incidence of sensory ulcers in hot climate conditions. France and Scudiero (1946) in a statistical analysis of unstinkness in the south-eastern United States found that the incidence rose throughout the year increased remarkably continuously with the temperature. In their observations of unstinkness amongst American troops in desert areas during the last war, Parviz and Elvins (1947) noted a marked overall incidence of sensory ulcers and also seasonal variation with an additionally increased incidence in the hotter months: they had the impression that those who were going to desert ulcers began to do so within a month of arrival in the desert, the peak incidence occurring after ten months in the area. Leonard (1964) of Panama, Florida, in a paper dealing mainly with the composition of nasal ulcers observed a 30 per cent increase in the incidence of sensory ulcers in this area during the hot season. Frank, De Vries, Aronson, Lovelock and Kofner, (1959) in an epidemic liquid survey of unstinkness in Israel found ulcers to occur more commonly in the hotter areas of that country but there appeared to them to be no simple correlation between incidence and temperature.

In assessing the influence of climatic conditions on unstinkness in the Navy, all those developing sensory ulcers as one of the three most common lesions, or within one year of returning home had their unstinkness attributed to their service on that station. In this way it was shown, that the incidence of unstinkness doubled itself in the Mediterranean area and was more than three times the home figure in the Middle and Far East Stations. The rates of incidence are as set out in Table 3.

Table 1

| Area | Preferendum | Male/Female | P/F ratio |
|------|-------------|-------------|-----------|
| 0.80 | 0.8 | 1.1 | 1.1 |

(continued)

A direct comparison between the effect of hot climate conditions on the mortality of calves in the Navy and in a civilian population group faced with a similar problem of accommodation was made possible by the inquiry by Frank et al (1959) into the occurrence of acclimatization in European contingents living in the harsh climatic conditions of Israel as this survey appears to have been carried out from observations made in semi-closed communities: no accurate determination of acclimatization has therefore been facilitated. They found that the incidence for a similar average age group in the Israeli survey was 12.6 per thousand a figure greatly in excess of that 1.5 per thousand for Naval personnel serving in the Middle East for two distinct areas which are fairly comparable to conditions found in tropical climatic conditions. Frank and his co-workers felt that the high incidence found by them was at least partially attributable to an inadequate consumption of fluids by people unaccustomed to high environmental temperatures: a possible secondary factor in this respect was that a significant number of them as the same authors under review were taking up manual work in Israel perhaps for the first time in their lives and were therefore liable to even greater fluid loss as a result. In support of their contention that an insufficiency of fluid was one of the main contributory factors they established that the Arabs and indigenous Israelis had a much higher urinary output than the Europeans. As regards this however, the circumstances of Naval personnel serving in the Middle East and Far East Stations are quite closely comparable to those of European contingents who lived inasmuch as both groups are exposed to and working in climatic conditions in which neither of them are used or accustomed: in Israel notably despite the similarity in their climatic conditions the incidence in the Navy is one tenth that in the Israeli survey. It may be that this disparity is due to the greater length of time those in the Israeli units were exposed to their conditions as Naval personnel were usually in the tropics for periods longer than two and a half years at any one time. In this respect however Frank found that the majority of calves were lost within the first few years of going to Israel. Furthermore, as previously mentioned Perce and Bloom (1945) noted that the peak incidence of acclimatization in American troops in the desert occurred in the much shorter time of two months. From this it would appear that the duration of exposure to hot climatic conditions played fully as much the great difference between the incidence in the Navy and that in the Israeli survey. Since the diagnostic criteria for recognition of a case of acclimatization are similar in both surveys it is admissible to speculate whether other major factors are not influencing the Israeli figures.

Relationship of Urubekia to Multiple Hot Weather Episodes

It was considered relevant to try to establish how many of those who developed urinary calculi whilst serving in hot climates, conditions had previously or subsequently served in a similar environment without having done so. This line of enquiry posed the difficulty of finding a generally acceptable criterion for assessment. In this respect it was felt that since the great majority of the calculi in this series were primary and small with a tendency to pass only as reported or delayed symptoms, could be presumed in most of the cases, a calculus once formed was therefore anticipated as being most likely to give rise to symptoms within eight to twelve, allowing diagnosis within a short time thereafter and certainly within two years. However to allow the possible criterion that two years is too short a period of time, three years has been allowed in this assessment for a calculus to declare itself following each case of service in the tropics. It is felt that this criterion is reasonable for all except a minority of calculi in this series.

The investigation carried out on the premise showed that 45 per cent of cases who developed urubekia in hot weather areas had served once or even several times in these areas at least three years beforehand without giving evidence of having formed calculi on these previous occasions; the percentage may well be too low as there are difficulties in ascertaining an individual's full record of service in hot weather areas and a number of instances of such service may have been overlooked. In the same way 52 per cent of such cases are known to have served subsequently in these areas without having had symptoms of recurrence. The more significant of the two figures is the former one of 45 per cent because it may well be considered that having once developed a urinary calculus a recurrence on 15 years in the tropics would be, as considered by medical advice as to ensure health as adequate final advice, thereby negating the possibility of a recurrence.

If the criteria of assessment on this particular enquiry are acceptable then it would mean that climatic conditions in the cases which these figures represent can only have been a predisposing factor to urubekia and that there must have been a further precipitating factor which acted on one occasion but not on others.

Table 4

| <i>AN Survey</i> | <i>U.S. Civil Service (Panama/Barahona)</i> | <i>U.S. Army Service (Vietnam)</i> | <i>Danish Service (Laos and Philip)</i> |
|------------------|---------------------------------------------|------------------------------------|-----------------------------------------|
| 34% | 15.3% | 33% | 26% |

Recurrence Rate

The rate of recurrence of urubekia in this series was found to be 24 per cent. This figure represents the incidence of true recurrence of calculus formation; the survey was having been reported demonstrably clear of calculi between each

which "Care" has been taken in this assessment to exclude "false" observations due to multiple colitis. The Naval figure is compared with those of other series in Table 4. From this it is apparent that it approximates most closely the figure found by Larsen and Philip (1942) in their survey in Denmark.

Anatomical Distribution of Colitis

The general distribution of the colitis in relationship to the cecum, tract, as set out in Table 5 where also, the Naval figure are compared with those of several other series.

Table 5

| | <i>R.N.</i> | <i>U.S. Army</i> (Hersom) | <i>U.S. Civil</i> (Doddson and Clark) | <i>Swedish</i> (Larsen and Philip) |
|----------|-------------|------------------------------|---------------------------------------------|------------------------------------------|
| Caecum | 13 | 40 | 33 | 30 |
| Upper | 64 | 52 | 42 | 15 |
| Bladder | 3 | 1 | 10 | 5 |
| Malpighi | 10 | | 6 | 30 |

¹ of Table

The low incidence of vesical colitis in the Naval and United States Army surveys in contrast to that of Doddson and Clark's figures, probably reflects the younger age average involved in an armed forces survey as opposed to that of a general population group; vesical colitis shows a tendency to increase in proportion to the frequency of lower cecum tract observations (Doddson and Clark 1946).

The distribution of colitis within the cecum, as terms of the upper or lower bladder was substantiated for comparison with the findings of Wessbury White (1944) and Price and Scardine (1946) in their surveys. These are set out in Table 6 and the three sets of figures, are seen to be generally in agreement.

Table 6

| | <i>R.N.</i> | <i>U.S.</i> (Price and Scardine) | <i>C.N.</i> (Wessbury White) |
|---------------|-------------|----------------------------------------|------------------------------------|
| Upper Bladder | 20% | 14% | 25% |
| Lower Bladder | 80% | 76% | 75% |

Treatment

(1) Renal Calculi

Twenty-eight per cent of calculi which were initially found to be within the kidney were subsequently passed spontaneously. 73 per cent received operative treatment.

Operative treatment was as follows:—

| | |
|---------------------|-----|
| Pyelolithotomy | 41% |
| Nephrolithotomy | 54% |
| Partial Nephrectomy | 23% |
| Total Nephrectomy | 14% |

(2) Ureteric Calculi

Of all ureteric calculi 34 per cent passed spontaneously and 56 per cent were removed at open operation. The remaining 10 per cent were dealt with by means external means per cutis abdominis, in this proportion included those calculi which were passed subsequently in ureteric colicostomies, were brought down by a ureteric basket or were released by distending of the ureters online.

Distinction as between upper and lower ureteric calculi revealed the difference in the management of stones in each situation. This is shown in Table 7.

Table 7

| | Spontaneous Passage | Distraction cut | Operation |
|--------------|---------------------|-----------------|-----------|
| Upper Ureter | 24% | 16% | 53% |
| Lower Ureter | 35% | 37% | 14% |

Associated Conditions

From a study of the individual medical histories of the stones in this series the association of calculi with a number of other diseases which have been associated in the past as perhaps having an aetiological bearing on the development of urinary calculi has been ascertained.

(1) Genito-Urinary Tract Infection

In his review of possible aetiological factors involved in urolithiasis Winbury White (1964) considered the possibility of an infective origin for some calculi, the evidence in respect of urinary calculi occurring in the third, fourth and fifth decades of life. He pointed out a previous infection could have (perhaps at only microscopic and microscopic) as providing a nidus or giving rise to changes in urine composition and composition thus leading to calculus formation. In addition similarly to previous lower urinary tract infection, he felt that evidence of infection spreads to the lower urinary or genital tracts could be considered just as valid as the presumption of a medical renal focus more than three times removed, an ascending infection in the urinary tract possibly subclinical in its effect could have arisen. A history of

the significance of previous infection in these cases as a cause of urethritis might therefore be regarded as of significance. Accordingly in this examination of the relationship of infection with urethritis, previous infection at all levels of the genito-urinary tract has been considered as well as back cystitis and pyelonephritis.

The incidence of acute infection in this series, was found to be 32 per cent. This compares with an incidence of 26 per cent as assessed by Harrison (1945) making use of the same criteria, in a survey of urinary infections in a United States Army Hospital. Winklerberg (1951) of Sweden found associated infection in 32 per cent while Winklerberg-White (1955) in his review of 500 cases found evidence of infection or previous infection lesions in as many as 74 per cent.

In his observations on over 600 cases of urethritis, Winklerberg-White (1946) drew attention to the preponderance of epididymitis arising on the left side of the urinary tract, in his series: left epididymitis occurred one and a half times as often as right-sided epididymitis. He interpreted this finding as arising in connection with infectious renal lesions being caused of some, certainly many, with more direct consequences on the left side between the upper and lower urinary tracts by vessels and lymphatic channels, as bacteria from a focus in the lower urinary or genital tracts would be the more likely to reach the left testis.

In the light of these former observations an assessment of the comparative incidence of right and left sided infection was made in this survey. The assessment was made both in respect of the whole series of cases and, again, considering only those cases giving evidence of past or present infection in the urinary tract. The findings may be set out in Table 3.

Table 3

| | Left | Right | Bi-lateral |
|------------------|-------|-------|------------|
| Whole Series | 66% | 46% | 16% |
| Infective* Group | 46.5% | 38% | 15.5% |

Left sided infection has been found to be just predominant and the factor of pre-dominance is slightly greater in the infective group. There is not however the same disparity in the incidence, of left as opposed to right sided infection as in Winklerberg-White's series.

In other surveys Harrison (1945) in his series found 47 per cent left sided infection as opposed to 42 per cent on the right side. Laxer and Philip (1945), however, found 59 per cent, to be right-sided infection and 40 per cent on the left side, 60 per cent being bilateral.

(2) Pyeal Ulcer

The incidence of confirmed pyeal ulcer listed in this survey was 3 per cent. In a control series of cases selected at random the incidence was 2 per cent.

There are several possible interpretations of this most frequent recognition of patient relief with tritethanol in the first instance: it may be attributed at least in part to a week of prolonged anastal therapy and an abundance of dietary salt, on the other hand, it is possible to postulate a common aetiology. In the latter respect, however, it is necessary to point out that, in the whole of the survey, there was only one confirmed case of hyperparathyroidism, an incidence of slightly less than 0.5 per cent.

(3) Previous Fracture

It has been postulated that the mobilization of calcium following a fracture is aided both by the release of a certain substance which is excreted in the urine, may be due to even possible alkalotic stimulation in the urinary tract.

In consideration of this an assessment was made of the incidence of previous fractures or significant bone disease in the cases in this survey. This was found to be 17 per cent., a smaller assessment in a control series of cases showed an incidence of 19 per cent. There is therefore no evidence of a significant association between osteoporosis and pathological processes involving bone in this survey.

Osteoporosis and Body Weight

In the course of scrutiny of the medical records of the cases in this survey the impression was gained that a significant proportion were overweight. The height/weight ratios of the cases in this series were therefore compared with physiological averages (Tables from the Life Extension Institute of New York). The weight of approximately 100 lb. was found to be above the accepted upper limit of normality. By contrast, a control series showed a much greater conformity with the average.

It is recognized that this association between relative obesity and osteoporosis may merely represent the additional disadvantages of excessive weight as a bad dietary, particularly higher sodium and is more profound the resultant dehydration requiring every correction. Another major factor has however been involved: these overweight cases of osteoporosis were personally encountered within the last year who developed their urinary calculi while in growth-retarding short final stature in accordance with the features of a dwarf.

To summarize in conclusion, this survey has sought to draw comparisons between the circumstances of osteoporosis in the Navy and those in other surveys: it has shown the pattern of occurrence of osteoporosis in the Navy to be linked partly with obesity, diet and partly with chronic anorexia. Lastly it has served as a pilot survey in the setting up of a permanent register of osteoporosis in the Royal Navy.

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Discussion Following Paper

Discussion opened by Surgeon Lieutenant-Commander RICHARDSON. I would really like to congratulate Surgeon-Commander Blacklock on the conclusion of his paper which raises some interesting points.

It kind of baffles me sometimes why there is not a higher incidence of urinary calculus in the Royal Marines, particularly as I understood that where they go on marches in the jungle in hot climates they are allowed only two pints of water a day with which to wash and drink. Possibly the explanation for that is due to the fact that they are very much more active during the time of their debilitation compared with sailors on board ship. Physical exertion may well be relevant in this respect as it is interesting to note the higher incidence of calculus amongst women gymnasts and not tennis stars.

The decreased incidence of calculus in regions where rain during the latter part of the Survey is of great interest, and may well be, due to the better living conditions in hot humid areas where which have been provided since recently.

By the same token the high incidence of calculus during amongst officers may well be due to the same factor as on the whole their water intakes would be expected to be lower certainly on big ships, is not so conditioned and on the Far East temperatures, in other circumstances.

Mr CECIL WAKELEY. I would like to thank Surgeon-Commander Blacklock for his excellent presentation and especially the way the slides have been prepared. I don't think they could have been done better. Now the discussion is thrown open.

Surgeon-Captain SHEPHERD (RNR). I must say I enjoyed this paper very much. One or two points occurred to me. First of all as regards water potentials it has been suggested that the very increased intake of salt and alkalis might account for the figures produced. The next point is that one has always appreciated, and I think rightly, that the patient who is in hospital for a long time drinks a lot of sweet orange squashes and things like that and by doing so in fact takes a lot of water

and thereby perhaps predisposing to infection. In the Navy we used to have a sort of lime drink in hot climates. I don't know when the composition was, but I wonder if the chemical content of this might be such as to have this effect.

The final point I was interested in — have the recurrent calculus cases been investigated for parathyroid disease? One knows that there are extraordinary discrepancies in the figures of parathyroid disease in relation to renal calculus and figures as high as 20 per cent have been quoted. It might be very possible in the Naval Service to investigate this point quite easily.

Surgeon Commander BLACKLOCK. In fact all recurrent cases have been very thoroughly investigated and any doubtful cases have been investigated in St Philip's Hospital, London. In fact as I've said there is only one confirmed case of parathyroid disease in this series; there were a number of cases of nephritis and a number of others (one who had congenital defects of the urinary tract) which had predisposed them to urinary calculus. These, of course, have had a short lived career in the Navy because we had to arrest them with these symptoms.

Surgeon Commander KIRKPATRICK. I would like to ask Surgeon Commander Blacklock whether the figures in this series include cases in which there was a history of classical renal colic and the physical signs, but in which a stone has not been shown. Recently we went through the case records in relation to all cases admitted there with both proven urinary calculus and renal colic. Quite a large number of cases were admitted with urinary colic of short duration in which renal cells were found in the urine but in whom subsequent XRF failed to reveal any stones or calculus.

It is interesting that in comparison of the admission of these cases of proven urinary calculus in whom no significant renal abnormality occurred, there was a very high incidence of this condition of renal or urinary colic without a proven stone in the hot months and very little occurred in the colder months.

Surgeon Commander BLACKLOCK. I am sorry I did not make it absolutely clear when I stated that the cases considered in this survey are only patients in whom a calculus has actually been seen on X-ray or have occurred either by spontaneous passage or at operation.

Mr Vice-Marshal Sir Peter DIXON. I would like to ask, what is the subsequent course of events in flying personnel re-employment and follow up after the passing or retention of the stone?

Surgeon Commander BLACKLOCK. This is, in fact, not asked, which point, out of my jurisdiction altogether because at this stage the case is taken over by the Air Medical Board. They actually make the decision themselves because they feel, and quite rightly, that I am not qualified to decide as to, particularly, fitness for flying.

Surgeon Lieutenant Commander RICHARDSON. In other words, having made the present PE from one point of view, but eventual return to flying is decided by the Air Medical Board and not by us, though we in fact make the initial stone decision as regards the general medical fitness.

Surgeon Commander GANDELL. I was interested to see the high incidence

among Officers of senior ranks. Could this be associated with the older age group of the Officers together with their more sedentary occupations, especially in the older age groups?

Surgeon Commander BLACKLOCK. This of course is quite possible because the bulk of personnel in the Navy fall between 35 and 50 whereas the majority of officers are in the 35-45 age group and it is well known that the incidence of coronary calcification increases drastically to increase to a maximum between the ages of 45-55 so that is very definitely a possibility.

Dr CECIL WAGLEY. I think that about brings the discussion to a close, but there are two points I would like to raise: one is in fact that period explanation today for calcification is a relatively simple operation and gives very good results. This is a great step forward I think in the treatment of coronary calcification. The other is having been Director of the Medical Insurance Company for over 30 years which only insures doctors and dentists, it is interesting to realize that people, doctors or dentists, who have coronary calcification and do not have an operation are heavily excluded and we have followed up those patients who refused operations for some in the winter and it is only about 5 per cent which cause trouble afterwards according to our records. The other is if a doctor or dentist has an operation for a coronary calcification he is excluded as regards a second or third for three years and if one does I suppose within five years he is given a class B of health which is rather narrow up from the point of view of insurance.

Now I am sure you would all like me to thank Surgeon Commander Blacklock for a very stimulating paper that stimulated and the subsequent discussion.

CHONDROMALACIA PATELLAE — A SERVICE PROBLEM

By Surgeon Lieutenant-Commander P. C. FOLLIS, RN

William Hunter in 1770 writing on articular cartilage stated an interesting but often an impressionally allowed to be a troublesome disease. It seems of a cure with more difficulty than a cannon ball, and when destroyed is never fully recovered.

The term *malacia*—Chondromalacia patellae is the floridly degeneration of the articular cartilage of the patella. This change is identical with that seen in the articular tissue of osteoarthritis of any joint, but has some special features.

The patellar cartilage is the thickest in the body and is the site of the earliest degenerative changes of any joint surface. Post-traumatic and arthritic diseases of unaltered knee joints in various authors (Dyer 1934; Bennett, Weiss and Bloor 1942; Salford-Smith 1951) have shown that changes may take place in knee lesions at ages childhood, are present in some degree in the majority of knees in the late twenties, and affect all knees by the age of thirty.

In most people these changes are slow and do not produce serious symptoms even when they merge into frank osteoarthritis, perhaps partly because of the decreasing demand on the knee with advancing years. Minor symptoms of aching and cracking are however common and are accepted as rheumatism or just 'old age'.

In a small group of young patients the cartilage changes may produce symptoms which can be severe or even incapacitating. It is this group which will be discussed. Some care with terminology is necessary as the word chondromalacia has been used both for the pathological changes which are stated, and often symptomatically and for the clinical syndrome which may be associated with them.

It is also necessary to see some arbitrary distinction between chondromalacia and frank osteoarthritis though it is almost certain that both are stages of the same process. Although the pathological process is continuous, symptoms may be minimal throughout some only with established osteoarthritis or in advanced chondromalacia is becoming acute at the stage of advancing cartilage damage. A notable dividing line, and in several authors, is the appearance of bony rubbing plates in the joint edges on X-ray.

The Service interest in chondromalacia patellae arose from the apparently high incidence in its active young men, and in the difficulty of, and high failure rate in treatment. Some seven cases seen at the Royal Naval Hospital, Haslemere the first five years have been followed. More cases were seen there, but the selected cases comprised the more serious or resistant cases, which were either excluded out of the Service or came to post-humous. Twelve more men were included after post-humous failure of conservative or limited surgical treatment. 40 had post-humous 2 followed of which 15 returned to full duties and 12 were excluded. It can be appreciated that this is a considerable wastage of man power. The average age of this group was 21.

These conditions and aviating figures should be seen against their Service background. Royal Marines are Commandos and undergo a rigorous training including assault courses and long speed marches. Naval ratings do not need to be given to achieve excellence have a high standard of fitness and at sea require virtual backlifts in particularly trying situations on the beach. The results of this background are that the naval surgeon tends to see cases earlier and with lesser complexity than his civilian colleagues and is less able to ignore them or the general practitioners with resources and advice to take things easily. Another factor is that the standard of results of treatment is not higher. Many wounds closed in the trenches in variety of particularly the example to good or even excellent would from the death zone in those papers be excluded from the Service. We must accept that results against the background of an attack course or of a serious battle in a ship's engine room or a job. In such circumstances even minor post-traumatic or reflexive may assume serious proportions.

Chondromatous patella was first described as a source of symptoms by Bostinger in 1898. He described it as direct trauma and limited it by exclusion of damaged areas of the articular cartilage. Interest in the condition was largely confined to Scandinavia until the last twenty years, review, and discussion being published there by Ahlman (1925), Owen (1934) and Karlsson (1954). The first British paper by Clapp in 1942 described two cases and advocated treatment by patellectomy. A detailed review of 48 cases was published by White, Andrews, and Dwyer in 1976 with a follow-up of those cases previously treated by arthroscopy during, in 1969. Several papers, notably those by Gaiterbridge (1961 and 1962) have discussed the aetiology.

The symptoms produced by chondromatous are characteristic and the diagnosis may often be made from a detailed history alone. The patient is as far as he knows an inveterate and disorder as difficulted walking in the front of the knee. He may have a little stiffness on first moving the joint and has a sensation of catching or of clunk going away at times. Symptoms may or may not have been started in such order by trauma. At first the ache is only troublesome after exercise and settles with rest but later appears with less exercise and tends to persist. Pain is noted on climbing and especially on stairs, often being worse on ascending. Descending is experienced as sitting for a while with the knee bent as in a crouch or in a car seat. This can be eased by working about. Pain may, rarely become continuous with swelling and even some heat in the joint and there may be pain at rest at night.

Last great modes of presentation are occasionally seen. Reversing off-road cars the knee may be the first complaint and some cases have been seen with gross swelling, almost painless, and impaction had commenced patellofemoral contact. A rare presentation was only once in this series, but the ordinary one of noisy clicking and creaking on stairs. The picture may of course be confused or complicated by a coincident mechanical disturbance of the knee but pain worse after exercise, no pain and slowing sitting, is characteristic.

The signs are often minimal and this coupled with the usually normal X-ray, may delay the diagnosis. The knee often looks normal, though there may be

a small effusion and possibly some synovial thickening. Range of movement is full and may be painful when not weight bearing. The knee is stable and painless in the usual tests for ligament integrity. Tenderness may be present in the patellar margins most commonly at the inferomedial edge, where in the flexed position it can easily be confused with the painless tenderness of a patellar bursa. Synovial thickening and tenderness are usually minimal but in a few cases have been enough to suggest a subacute infection or inflammatory process.

The three characteristic signs are:

1. Patellar crepitation when the knee and patella is passed over the femoral condyles
2. Rarer patellar tenderness elicited by finger pressure when deepening the inferomedial patella markedly
3. A patellar ache during severe resistance when weight bearing on the affected leg

Cruciate and meniscus grating can be detected in most adult patello-femoral joints. While this may mean that degenerative changes are present, it cannot account for pain in the absence of other positive signs.

X-ray including skyline or tangential views is usually normal. Campbell Goldring (1964) reports only 32 per cent positive findings of subchondral thickening or cysts in 160 cases. The cartilage lesions shall cannot usually be visualized. A careful examination of our series does, however, show quite clearly an apparent white sharpening of the edges of the patellar articular surface in the tangent view.

The **pathological changes** consistently start in the lower half of the smaller medial facet of the articular surface and spread centrifugally involving soon the medial edge and then the lateral facet when opening the edges of the cartilage surface. The first change is softness and softening. Flattening due to cyst formation may be seen and oblique irregular fractures often develop in the central zone. Flattening spreads irregularly outwards with deepening and the appearance of ridges of cartilage exposing eventually an alveolar like area down to the bone. At this stage the free beeping of the articular margins is apparent with synovial hypertrophy and hyperplasia. Most bone is exposed and eventually bony ridges and chondral at the stage of gross osteoarthritis (Fig. 11).

Microscopically the changes are identical with those reported for example by Harrison, Schapowala and Trueta (1955) in the first stages of osteoarthritis of the hip. The first change is alteration of the staining properties of the cartilage matrix associated with the death of cells. Cysts and fissures appear and extend deeply. Cartilage is irregular and upper processes are not seen unless fissures or macrophages extend into the underlying bone. Increased vascularity is seen in the loose connective junction and at the articular margin is associated with the appearance of osteophytes.

The **relation of pathology to symptoms** is uncertain, with great variation in individual cases where direct correspondence has been possible at arthroscopy. Since cartilage is non-painful, pain must derive from subsequent bone or from surrounding capsule and synovium. It has the characteristics of 'bone pain' and may well be related to vascular changes. It seems likely that the speed of the degenerative

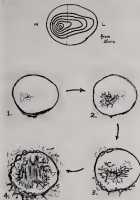


FIGURE 1. Patterns of development of chondroectodermal cartilage.

process determines the nature and severity of symptoms. Lloyd Roberts (1955) has demonstrated in rabbits the marked systemic reaction to injected cartilaginous cartilage fragments and the desquamation of Balne may thus be, a factor in the pathogenesis.

The early reports of chondromatous synovial cysts as the cause of the lesion. Acute cartilage fracture leading to secondary localized degeneration do undoubtedly occur (Cook, 1944; Chaffin, 1959) and this type may be one possible for the "runner" lesions localized to distal ends of the distal condensation supporting the patella at the time of injury. In this event the runner lesions were not, then, usually being a striking difference between the distal condensation and healthy lateral surfaces. The effects of a traumatic synovitis may well alter the lubricant and lubricatory functions of synovial fluid and thus predispose to damage of the bearing surfaces of the joint.

In view of the frequent localization of the lesion (over 20 per cent in the normal and its considerably constant localization as well as the associated changes in which lesions it is in the normal and abnormal mechanics of the patellofemoral joint and its daily wear and tear first attention must be drawn to any disturbance in walking. Endurance and rotation factors have been postulated but are now discounted. Several instances of limited involvement at an early age have been reported (Kendall, 1954).

Many mechanical derangements of the knee are associated with chondromatosis. The best known in this respect is rotating patellar dislocation and subluxation which if uncorrected eventually leads to wear and tear changes. Several authors have commented on the surprising lack of further degeneration after successful



Figure 1. Mechanism and Chondromatosis

surgical realignment of the patella (Hansen, 1934). Ligamentous instability may lead to early chondromatosis as may restriction of knee flexion of the joint by quadriceps adhesions from various infectious lesions or femoral fracture (Harris, 1944).

The relationship between chondromatosis and traumatic injury is complex. (Fig. 2) The effects of abrasion as mentioned above in connection with trauma may be of importance as well as purely mechanical effects. Some normal tissues are removed on a traumatic diagnosis, the removed tissue sometimes producing a histological improvement in any chondromatous symptoms. Two cases in this series had had meniscus cysts which had not shared their complaints. There are, however, eight cases in which a localized handle tear had been seen at a previous operation. Careful examination of torn before meniscus may reveal retroarticular condensation which usually settles in the recovery phase. On the other hand

Chondromalacia symptoms and signs may only develop after operation. Inspection of the patella during arthroscopy is contradicted by O'Donoghue (1959) as one of the best prognoses is to speed and quality of recovery. He believes that episodes of locking and delay before arthroscopy are important causes of chondral malacia. Heller (1962), however, emphasizes the alterations in the normal rotational movement of the knee throughout flexion and extension and his studies show that this is interfered with as meniscus lesions even if no locking takes place. The upper force of bending stress on the recently operated knee is important. Any delay and limitation and particularly extensive quadriceps exercises in flexion may precipitate postoperative damage.

The normal patellofemoral articulation allows a sliding movement of the patella through up to three inches from above the proximal articular surface on the femur to the more distal part of the condyles below. The distribution of stress over a large femoral surface may account for the relative freedom of this part of the articulation from early wear and tear.



Figure 3. Theories of aetiology of chondromalacia.

Figure 4. Position of the patella.

Two views attempt to account for the localization of chondromalacia on the joint. Wilson (1941) after a detailed study of the patellofemoral joint drew attention to the relative obliquity of the distal ends of the joint in flexion of over 70° with the possibility of severe local pressure. He also considered that chondromalacia was more likely in the type of patella with a relatively small medial facet (Fig. 3). O'Donoghue (1961) suggested that the apposition of the patella to a fibrous ridge in the upper end of the medial femoral facet is more flexion and limited by release of resistance to the angle between patellar facets.

The action of the patellofemoral joint is to transfer the power of the quadriceps muscle across the knee joint. By tilting it as were the top of pull away from the axis of movement especially in the range 30° to 60° flexion the patella confers a mechanical advantage, which is modified by patelloctomy (Fig. 4).

This transfer and change in angle results in compressive and shearing forces

on the palatal arch, from the latter being, directly measured, more than 15 mm. dependent on available space. The compressive force, as transmitted laterally, can often well reach its peak greater in force, when.

An average man can exert a forward pressure of the teeth of 30 lb. at the middle region in the range of 15 to 40 degrees. Measurement of the forces involved shows that this is equivalent to a force of 400 lb. in the palatal ligament and quadrangular tendon (Fig. 4). The compressive force on the palatal forward articulation may then be estimated from a parallelogram of forces and shown to increase rapidly with force, being of the order of half a ton at 40 degrees (Fig. 5).

At about 30 degrees the palatal stress from the vertical groove formed surface is in between the condyles on the pressure received by the teeth on extension. During extension there is a fairly sudden tilt away from the axis of movement at the level. Most fetters show a defined ridge at this point which is not evident on the X-ray because of superimposed outer condyles. It is necessary to recognize this part of the ridge for the earliest diagnosis. It is also surprising



FIGURE 4. The palatal arch, with lateral forces. FIGURE 5. Palatal arch, with lateral forces.

to indicate that osteochondroma, however commonly developing on the outer margin of the lateral condyle, may be caused by stress factors due to the same impulses. (Fig. 6)

In view of the influence of violent activity little has been published though Howell (1963) states that osteochondroma is common in professional cyclists. There is still controversy over the relative incidence of osteochondroma generally to occupational and sedentary markets. However, Martin (1963) may have an inkling as to the fact that half the recorded patients came from the Marines, although the Corps forms only an eighth of the population at risk.

may be of two types—the round bony capsule which is characteristic of minor arthritis and the disc fissure creating that is found in cases of ankyrosis. The latter type suggests that a failure of pacific forward inflexion is an important part of the syndrome.

It is noted that Charnelange had described a ridge on the superior part of the articular surface of the medial femoral condyle as being an important predisposing factor. I have been a study of the knee of a woman of 30 operated in operation which demonstrates this ridge, but also demonstrates that the point at which the disc pressure was occurring was situated a good deal further distally on the medial femoral condyle than the ridge. Other studies of the same patient's patella demonstrate more than on the medial articular that there is no loss of tissue, mechanical or functional, the cartilage being pink and continuous. It also shows however that the cartilage on the lateral articular face is worn and irregular though not showing evidence of active inflammatory reaction. I wonder which of these two types of knee should be regarded as the predecessor of minor arthritis or whether both were involved.

Asr Commissioner CHICKERMAN: I would like to emphasize the importance of the ridge at the upper end of the medial femoral condyle surface. In eight extended operations of this ridge in cases of failed patellofemoral I have been pleased with the results of cartilage shaving combined with ridge reduction. I have the impression that the condition is commoner among young females and have operated on one 15 year old girl.

Surgeon Captain de TURTLE RN (Ret): My experience as a School Medical Officer confirms that the condition is, when looked for, common at the femoral.

Surgeon Captain MURCHISON RN: I consider that patellofemoral is a fairly early stage in the knee management.

Surgeon Commander JONES RN: I would agree with Surgeon Lieutenant Com mander Peckard that prolonged rest alone cures and that Wray Gaffney are the chief authors of conservative treatment and that the statistics of these cases is disappointingly slow. The results of shaving the patella are rather disappointing and patellofemoral though giving many very good results does not go clear made up to the existing standards required of Commonwealth. Some years ago Mr Jackson-Brown drew attention to the fact that these patients must not be given exercises which involved straightening the knee from flexed position. The condition is aggravated by the severe pressure between the patella and the femoral condyle, which is produced in this way.

Mr JACKSON BURNOWS: I would emphasize the importance of avoiding the resting position which have so often in the past been prescribed for knee in pain. The condition is almost the only one in which the patient will complain that pain is worse going up than coming down stairs and hills.

Surgeon Lieutenant PULFORD: In thanking the contributors I must add that I am not so concerned as Asr Commissioner Chicks of the importance of the Charnelange ridge partly because of the lack of damage to the ridge in a series of arthroscopies and PM. review. The RN Medical Service is very conscious of

the design (I would qualify) that was in design more in the material or training, physical, social, spiritual, world elsewhere.

In that WARELY has not you would all like me to thank Fildford and Jones for their papers this afternoon. My experience as a general suspect is that the parallel is unique in its own characteristics in the fourth month of local life and this conclusion in the fourth year. I do not think that along intense play much part in the handling of the condition, especially in some of the frequency of full recovery from the very common marking and looking reports obtained by boys in school.

NAVAL INFLUENCES UPON THE SURGERY OF PEPTIC ULCERATION

By Surgeon Captain J. Watt, R.N., Professor of Surgery

The modern ulcerist is subjected to influences which not only render him more susceptible to peptic ulceration but pose problems in its management and eventual treatment and in its ultimate disposal.

Reported from home, often with unassisted family problems, frequently of financial means owing to late purchase commitments, being a confirmed tobaccoist, a background of some tension and intense anxiety, provided with cheap cigarettes and power alcohol by a government ration in return for services volunteered often to work a tight system, which may involve twelve hour watches under tropical conditions, or order to maintain complex electronic machinery and keep expensive complicated vessels in the air, patrolling on war zones, dangerous mountain passes or isolated shores, it is little wonder that conditions young men suffer dyspepsia and find their way into naval hospitals for investigation. Naval personnel admitted to the Royal Naval Hospital, Haslemere during the years 1960 to 1964 included 1498 cases of gastric peptic ulceration. 938 of these were treated moderately, of whom 714 were recruited from the Service and 100 received surgical treatment, of whom 8 were subsequently recruited. The pattern has, however, varied from year to year (Fig. 1) but with a tendency to recruit fewer patients and offer more, but perhaps not yet enough, surgery.

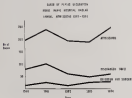


Figure 1

In making our selection, we are assisted by the results of Samuel Johnson (1961) that, for who does not mind his belly, will hardly mind anything else, and the reasoning proved to be sound, namely, between the ages of 40 and 60. In fact, 33 of all hospital patients were Civil Party Officers, a category representing only 11.7% of all Royal Naval and Royal Marine personnel. One reflecting the effects of his, possibly under the adverse circumstances of Service life as a humble, highly trained key technician, whom the Navy can ill afford to lose. These veterans in the 40s may be highly desirable, but the issue is complicated by various regulations which allow a total of only eighteen months for the completion of all medical and surgical treatment and not patient surveillance before, return to full duties under any conditions anywhere in the world.

It is a tough practical line of gastric surgery for much stronger than any applied to the statistics published under a study of civilian cases. For example, Hols and Lyttle (1960) include in their 41.4% of morbidity results from vagotomy and anterior pyloromyotomy 21.4% with mild post-operative symptoms, only 10% with mild symptoms not controlled, when we would not regard as satisfactory in Service patients. Popper and Poppel (1963) reviewing 248 cases of chronic duodenal ulcer treated by total vagotomy and gastric pyloromyotomy include very mild symptoms in their excellent category and moderate personal side effects in their good group. In our own mixed naval and civilian practice, successful gastric surgery is judged by very different standards in the light of the different way of life of civilian and Service patients. The present series of 105 mixed civilian and Service cases represents various types of gastric surgery performed by different naval surgeons upon Royal Naval and Royal Marine personnel only. Post-operative complications were few and not serious (Fig. 1). Civilian cases have been excluded.

POST-OPERATIVE COMPLICATIONS, 105 CASES

| | |
|-----------------------------|----|
| DIAPHRAGM, WOUND, ABSCESS | 12 |
| CHOLELITHIASIS | 1 |
| WOUND DEHISCENCE | 1 |
| EMPIEMA (POSTERIOR STOMACH) | 1 |

MORTALITY RISK

Figure 2

The type of life to which our patients return determines the quality of the final surgical operation which is to:

1. A low survivorship rate. The post-operative survivorship rate is a determining factor in the initial gastric operation and the risk of total gastrectomy is high. Operations which fail to deal with high acid levels, or which are followed by gastric metastases must therefore be avoided.
2. Complications capable of being managed with complete safety as far as possible for perhaps several days, by both hospital staff with limited knowledge using simple measures. Large operations which, in themselves requiring emergency care put at too early a price rate.
3. No tendency to post-operative symptoms which might aggravate conditions. The causes and treatment of the dumping syndrome or post-vagotomy gastritis and flatulence might become a serious or even desperate disease.
4. No tendency to malabsorption. There is no alternative to the dog's food and the small stomach syndrome of an ulcerated gastrojejunum or the intestine which may follow vagotomy and drainage procedures may defeat the object of the operation.
5. No late onset sequelae such as post-operative diarrhoea, non-compliance as a delayed, unwanted complication. Vagotomy is the chief offender. Borge (1964) tells of a patient treated by total vagotomy and gastric resection who suffered attacks of urgent diarrhoea while on a dog's diet.¹

It would seem therefore that none of the gastric operations currently in vogue, fulfil all criteria. Which to choose? Cameron (1964) described two of the present human stomachs as 'to have a stomach and half more or to have most and lack 1 stomach' and this appears to be precisely the dilemma confronting dyspeptic today. For patients who suffered all kinds from gastric ulceration now run the risk of emptying metabolism from the consequences of gastric surgery which, in some centres (Hardy 1964) has been placed as high as 60% while post-vagotomy diarrhoea is reported to have been in the region of 15% or 18% in some series (Dixon 1964) although Cox and Read (1965) found that while epistolic diarrhoea occurred in 71% only 2% of post-vagotomy patients were incapacitated by it. Nevertheless, this is unacceptable as was Ramsdale (1959) describing the aftermath of vagal crypex as the present flight from gastrojejunum instead of just the situation and suggesting as Dwyer's words that the bad results of gastrojejunum are the result of bad gastrojejunum provided for adequate removal of the acid bearing area of the stomach and a technically skilled operation with attention to the detail laid down by the great masters who had found a thoroughly satisfactory, pointing out that Tanner (1932) and Forras (1952) had found that over 70% of gastrojejunum as their heads had been amply successful. Forras eventually criticised his 5% failure rate as fully correct technique. The patient's whole pre-operative make up as to later current results.

Many of the earlier Heister cases were autopsies. Polyp type gastrojejunum with a Hefmeister valve and short afferent loop brought up to the lesser curve of the stomach. While often giving excellent results it has been followed commonly by

basal dermis, etc. were very distal to the food niche. We were surprised to find this typical pyloric profile reproduced by larvae which in human studies eat two of the parasites. One also developed ectoparas following vagotomy and pyloroplasty and in whom complete nerve section had been confirmed by the muscle test. We thought to have gastric retention with persistent narrowing of the duodenum immediately distal to the pyloric antrum. Starling was attributed to gastritis in the mouth of animal resistance and the stomach in an inadequate pyloroplasty. Another developed a gastric ulcer in spite of continued nerve section and apparently adequate pyloroplasty, but the human profile was typical. It seems probable that most of these cases will be reported because the operation of pyloroplasty entails routine biopsy of the pyloric muscle in a manner likely to encourage gastric retention.

In the most McKeating-Wynberg operation (McKeating 1938) a siphon or sigmoid incision is made from the stomach to the duodenum through the pylorus (Johnson & D 1955). Symptomatically it length (Hodge 1964) and the siphon is then drawn into the increasing size to broaden the suture. The results first as division of the circular fibres of the pylorus, sphincter which becomes shorter and thicker and being uncontracted contract with after rapid action (Horsley 1955). It is separated from the muscular layer of the duodenum wall by a barrier of connective tissue bridged by a few muscle fibres only. The thick contracted circular muscle now occupying the siphon segment of the abdominal ring appears to be too powerful for the food release which seen on human studies.



FIGURE 4. *Ex vivo* a distended, contracted stomach, opened, pyloric antrum removed, view from of a pyloric plastic cylinder closed (long 1000 μ), 10 \times magnified and wet.

Finally, the longitudinal muscle of the stomach contracts upon the pylorus and so forms an embracing layer (Fig. 4) and it is this which is contracted into the

strongly as an invagination of a sword shaped defect produced in the roof of the stomach by invagination of the greater curvature. The roof does not remain closed as we suppose for collagen pulled by the pull of its longitudinal muscle and this is responsible for the shallow nature of the roof so that ultimately a pyloroplasty equals or equals narrowing of the central distal part of the pylorus and then lead to two large dysmotile fig. 54 which means largely one of the more chronic, their rates and need receptors, no doubt lasting quite differently from those in the more well known and perhaps subacute narrowing the rate of gastric emptying and gastric volume. This may help to explain why hernia is frequently common place of a series of failures and discomfort after pyloroplasty.



Figure 5. The effect of pyloroplasty (left) on a normal stomach (right).

It therefore appears that lesser degrees of vagotomy and pyloroplasty operations may reveal an increasing tendency to recurrent ulceration with leading to fibrosis leading to organic obstruction. The result of gastric retention and prolonged retention of gastric secretion. This is of particular importance in those cases in which ulcer is a potential ulceration at present in the state of operation, ulcer healing may be delayed and extensive fibrosis occurs with unpredictable consequences. The operation of vagotomy and pyloroplasty recently described by Holt and Lytle (1961) which follows the technique of "excision and partial duodenectomy" described by Judd (1922) is open to the same objection as the McKeen as that work up is done to remove the distal stomach and obstructing circular pyloric muscle, and it is necessary to note the popularity of the Judd pyloroplasty in the United States was their level (Mannig 1955).

Will have not been subjected to vagotomy and gastric jejunostomy because this appeared to offer the worst of both worlds — the danger of loops and the complication of vagotomy. While a fundus is removed in the stomach beyond the stomach, it will probably be the stimulus in a prolonged neural phase of gastric secretion and is probably the reason why recurrent ulceration has been high in some series.



Figure 5. (a) Effect of vagotomy. (b) Effect of vagotomy and gastric jejunostomy. (c) Effect of vagotomy and gastric jejunostomy.

bowel, ileitis, proctitis, and gastric jejunostomy may be different reasons. Is followed by high gastric acid and a tendency to recurrent ulceration in spite of antacidary vagotomy: the only operation which appeared to meet out gastric jejunostomy was the ileostomy. Is induced in ileostomy (1947) (Fig. 5). It usually the Polyp loops and their extensive dangers namely obstruction from adhesions and retrogastric hernia (Gunnery, 1954; Bessie and Haddy 1960) antegrade jejunostomy, obstruction (Brown and Lacey 1970) and afferent loop obstruction in the lower small intestine causing recurrent ileitis (Casper and Hunter 1951; Taylor H 1956). The future manifestations of the dumping syndrome associated with food shifts from the plasma and intercellular space in the lumen of the bowel (Robert, Randall, Fair, Robert, McRae and Park, 1954) partial jejunostomy (Cris and Allen, 1960) and reduction of the blood volume with perhaps release of autotoxins from the bowel wall (Haddy 1961) are very unusual, following gastric duodenal anastomosis. Moreover the Polyp operation through by passing the duodenum, provides mixing of the gastric effluent with the duodenal contents thus leading to malabsorption of fat (Gunnery 1951) and to failure of duodenal release of gastric contents reduced through cause and acid secretion in the duodenal wall (Haddy 1961) normally in contact with the gastric chyme.

However, although Bellmeh I operation has given consistently good results when performed for vesicle, most at first on oval neoplasms when performed for choledochal stone and Orr (1964) has placed the stone measure, rate as high as 15% although Nylon, Cauden and Barker (1963) report a second stone rate of only 3 in 9, following Bellmeh I operation for choledochal stone, while for years neoplasms have been largely cured by the clamping syndrome by converting Polyoxy operations for choledochal stone to Bellmeh I operation.

Nevertheless to avoid the risk of recurrent cholelithiasis, although meeting the problem of post-operative difficulties, vagotomy was added to a less radical Bellmeh I operation and Nylon et al. (1964) have reported excellent results from this operation. Most difficulties were encountered in the younger naval men, where choledochal dilatation is often of a particularly resistant type, accompanied by the reduced



Fig. 1. Gallbladder and
common bile duct, showing
the results of a Bellmeh I
operation for choledochal
stone, with a second stone
removed at the time of the
operation.

duct, and granular wall of an acute cholecystitis and perhaps an associated post-cholecystitis stone after prolonged medical treatment. In these cases we have found that vagotomy with a Bellmeh I gastrojejunostomy has been followed by a prolonged period of high gastric retraction from an acute, somewhat common even after early biliary neoplasms, early bowel sounds, the early passage of intestinal sounds and even

below vomiting. Polygastric studies have shown complete gastric atonia with spasm of the antral part of the duodenum due to a partial duodenal (ile. 7) depending only on a milk drip containing aluminum phosphate.

The duodenal effect upon the duodenal wall presumably determines duodenal spasm and resistance to emptying of the stomach gastric contents allowing the stomach contents to pass on. Secondary anastomoses are of no value in the duodenum and probably only impede intestinal absorption (Figures 19, A, C, D, E, F and Owen A. L. 1929).



Figure 19. Stomach and duodenum (Fig. 19, A, C, D, E, F, and Owen A. L. 1929).

Contra, retaining a not safe operation when used in a perforation or Polya operation for the gastric remnant is due entirely to faulty technique. Kemp, Harper and Caldwell, 1911 and 1913, actually split the stomach in two sides and to take no less advantage of this, in 1913, present a stomach and lower part of duodenum (Fig. 19) modified from an operation proposed by Hermann Taylor 19, claims that this operation by placing the stomach close to the ampulla of Vater has all the advantages of the Billroth I operation without the danger of recurrent duodenal ulcer. It does not however remove itself to the usual suspicion since there seems to be a real danger of rotation of the unsupported esophagus and obstruction by the surrounding transverse mesocolon when recurrent or perforation in the region of a stomach in this way would pose a formidable problem.

But vagotomy still must be examined more critically and while Anderson before any Vagotomy with division of the pyloric branches (ibid., 1924, fig. 9) has the theoretical advantage of preserving the gastric branches of the Vagus supplying the upper abdominal viscera and the lower there is evidence that paravagotomy,



Fig. 1. Effect of vagotomy on gastric secretion.

1950). The findings of de Vries¹ reach the paradox that the gastric problem will ultimately require that the vagotomy disturbance is due to pre-operative changes in the acid secretion for gastric and pancreatic release in patients who had their vagotomies pre-operatively. This implies careful pre-operative selection of patients on the basis of medical vagotomy (Gillespie and Kay 1961) because until 1950, it was held that 10% of vagotomies in which vagotomy appeared to

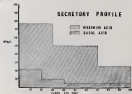


Fig. 2. Secretory profile of patients with gastric hypersecretion.



Figure 1
Dissection of the stomach
from a rat (210 g)
showing the location of the
vagotomy (V) and the
vagotomy (V).



Figure 2
Dissection of the stomach
from a rat (210 g)
showing the location of the
vagotomy (V) and the
vagotomy (V).

effective (Fig. 1b). These *in vivo* findings evidence to suggest that the local and hormonal phases of gastric secretion are sympathetic and Moore (1964) has shown that, even the augmented stomach, but does not represent the full secretory potential of the stomach. The vagotomy (Fig. 2) of one animal (animal 210 g) with basal hypersecretion and 12% with a high potential cell count (Fig. 1b).

Finally, while Barga and others (1964) suggest Vagotomy is not

vagotomy, (Smith & Hirsch, 1954; Hirsch *et al.* 1964) he was able to publish equally convincing statistics for his original Fenton or "Relaxing" Vagotomy which spared the median branch of the posterior Vagus (Borge and Clark, 1954) and which has now been found to be of little importance. (Gilbert Smith, Pomeroy and Peirce 1961; Smith and Pomeroy 1963). But the very design appears to have been administered by Rodley (1964) who dissected whole blocks of lower thoracic and upper abdominal vagus to reveal the distribution of vagal fibers to far more complex than Borge's schematic presentation had made them appear and, from his distribution, figs 11 and 12, it seems probable that the hepatic branches often may be divided inadvertently in selective vagotomy while doing very vagal fibers which are as carefully protected, can give off gastric branches, re-innervating the stomach across the lesser curvature or after passing through the coeliac plexus, thus ruining the whole procedure. It is also possible that vagotomy may diminish the protective neural secretion of Brunner's glands in the duodenum (Harrison and Kay 1955 and 1961).

It appears therefore that operations involving vagotomy shall remain unappetizable and will not have the excellent long-term results of a properly executed vagotomy. Yet for our understanding the shortcomings of the Fenton technique coincide with its potentially lethal complications and this has led to renewed considerations of the Fulkerson procedure done without vagotomy. It had in fact, given good results in the first series of abdominal ulcer for which it had been performed and these termed no valid reason why it would not give equally good results in duoditis as in gastric ulcer. Although Orr (1964) points to the difficulties of a short curved, fixed duodenum, the need for extensive mobilization of the upper and third parts of duodenum and of involving tissues at the lesser curve. Nyhus *et al.* (1963) have overcome the problems of difficult posterior ulcers by the Sereno maneuver and mobilization of the duodenum by the Kocher technique which would appear to further endanger the precarious blood supply of a duodenum which already has suffered the changes produced by ulceration. Moreover, gastric-duodenal ulcers have been reported following this procedure (Anderson and Dudley 1963).

The Fulkerson operation can be technically difficult and this, together with the fear of trauma to the stomach leads to inadequate resection of the acid bearing area. A hole of various sizes is made to cut the stomach across at low level, close the un-wanted portion and create a stomach at the greater curve than to carry out a radical resection, moving away the lesser curve as far as the gastric and thereby insulating a miniature stomach for the provera every intense burning within the abdominal cavity. Nevertheless, reference to Borge's chapter fig. 11 of the anatomy of the relations of vagus, with Hall, Richardson and Scarborough (1961) will show that, up to a three-fifths resection of the acid bearing area can be carried out by a radical Stenmaker method. This stepwise technique continues to describe non-satisfactory techniques. Forquharson (1962) shows change on the lesser curve from short down wards which is quite impossible in a radical procedure. Attempts to follow the technique would result in little more than an oesophagomy. Failure to shape the stomach remnant in Stenmaker fashion not only allows retention of the high acid producing lesser curve but also colling gastric-pyloric masses of mixed type

(Nelson et al., 1963) and has an important bearing upon the fate of the new stomach and function of the anastomosis.



Figure 19. Relative frequency of oxyntic cells forming acid, as indicated with the blackness of the print.

Density & Distribution oxyntic cells Berger



The convexity of the lower curve of the stomach normally leads greatly toward the open end as the Blandinger version of the operation, the new stomach readily outgrows this position (fig. 14) but if merely cut across at a low level, a blind lower curve, pouch, necks and sinuities in which the stomach packs the blind pouch opens the open parting the anastomosis, necks, sinuses (fig. 15) at the so-called *Angle of Lister*, and opening up the gastric (morphological) angle which Winter (1964) has shown may lead to ulcerogenic reflux.

The second technical feature of importance is to avoid over pressure, restriction of the duodenum which can be caused not only directly by gastric, upper where the duodenum is free and mobile but progressively the blood supply when leading by tension has followed duodenal anastomosis. Clamps on the duodenal staple are therefore avoided together with all unnecessary dissection of the duodenum from the pancreas, leaving a mass run of pancreas well to take the tension. This preserves the blood supply and prevents non-operative duodenal necrosis.

Thirdly, the incision must be kept enough to allow a good flow of gastric, chyme through the duodenum in order to create duodenal substitutes of gastric secretion. Hunt (1965) has shown that the celiac and acid receptors in a healthy duodenum can in part at least compensate for a limited degree of mechanical embarrassment



FIGURE 10. A. *Stomach of a rat* (100x magnification) showing marked deciduous (100x magnification) (100x magnification).

the gastric emptying rate the entire oral and anal receptors already may have been stimulated by pathological changes consequent upon the standard ulceration and a mild irritant is therefore, essential. Johnson and Diller (1964) have shown an adapted duodenal inhibitory response to acid in the ulcerated deciduous. Moreover it is possible that changes in the gastric mucosa resulting from chronic ulceration may lead to upper gastric secretions of a pH low enough to cause further ulceration and too high to stimulate the acid receptors.

The diameter of the duodenal lumen is also quite small and the stomach mucosa is made up to one and a half times larger. The posterior duodenal wall is then cut back to the pylorus, as the stomach already described having a larger lumen of anterior duodenal wall. The posterior mesentery is now turned out using its outer continuous, one muscular coat of 600 microns between the posterior wall of the stomach commencing a third of the distance along the stomach from the greater curvature and the whole of the posterior duodenal wall close to the pylorus. The entire is then gently pulled back to bring the stomach into apposition. A rat



Fig. 1. The heart of a human being, showing the left and right ventricles and the major blood vessels.



Fig. 2. The hand of a human being, showing the bones, muscles, and tendons.

incision causes already the danger of pinches from the faces of interrupted incision by twist pressure and distortion.

Next the all-cause OOO-chrome output incision completes the posterior incision. This short posterior diagonal will close to the pinches, but a further advantage is provided by tending towards autoincision of the posterior wall leading to partial normal obstruction. These incisions are now made into the anterior flap on, inside, along each side, and run down the center to provide two anterior flaps. The long middle anterior edge of the stomach incision is auto-incised around the flap, by means of an all-cause OOO-chrome output incision and pure muscular OOO-Muscular incision. The end result provides a broad shaped diagonal stamp joined to the stomach by an M-shaped incision (Fig. 16) through which passes the esophageal tube. Post-operative progress has been successful. Polygraph or fluoroscopic studies have shown that the diameter of the stom. has been maintained and pinches escaping the back normal flap. 17.



Fig. 16. Stomach, after operation, showing the M-shaped incision.

As a result of the results of various operations, a trial list for future operations in Royal Naval personnel at the Royal Naval Hospital, Haslemere is shown in Fig. 10. One patient who had a bilateral conversion of a gastric jejunostomy which had been carried out elsewhere for a perforated ulcer and was followed by symptoms of

POST-CONVERSION SYMPTOMS

| | SYMPTOMS | | CAUSATION | | TREAT |
|--------------|-----------------|------------|-----------------|------------|-------|
| | NO. OF PATIENTS | PERCENTAGE | NO. OF PATIENTS | PERCENTAGE | |
| DIARRHOEA | 11 | 100 | 0 | 0 | 2 |
| CONSTIPATION | 0 | 0 | 0 | 0 | 0 |
| HAEMORRHOIDS | 0 | 0 | 0 | 0 | 0 |
| HEMATEMESIS | 0 | 0 | 0 | 0 | 0 |
| STOMACH PAIN | 0 | 0 | 0 | 0 | 0 |

Figure 10

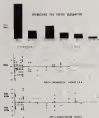


Figure 11

dumping complaint) of a dirty stomach and rectum as follow-up and on, (5) (6) who had a vagotomy and Balfour I operation without temporary vagotomy.

Weight has been well maintained and weight loss has occurred only in three patients. The only adverse feature has been a tendency for the haemoglobin to fall a little below the average fig. 15. One patient in the Balfour group was operated because he had already elected to leave the Service before operation, but was already symptom-free following a fig. 20.

In conclusion it is suggested that the Balfour-Bellith operation described marks out the three fundamental principles for a successful gastrectomy with gastric distal anastomosis, namely: a radical resection of the acid forming area of the stomach, preservation of the distal blood supply and a satisfactory gastro-distal anastomosis. It furthermore appears to be the only operation which will meet all the criteria for gastric surgery in those who go down to the sea in ships.

INVALIDED FROM THE SERVICE

| REASON | OPERATION |
|--------------------------------|----------------------|
| ESQUANT VAGOTOMY | POLEA |
| CONJUGAL STOMACH | POLEA |
| NAVYING AT SEA | POLEA |
| NAVYING AT THEATER OF SEA I | POLEA |
| NAUTICAL STRESS | POLEA |
| CONJUGAL STRESS | POLEA + POLEA |
| PERICULATING & PERICULATING | POLEA + PERICULATING |
| PERICULATING (CONJUGAL STRESS) | POLEA + POLEA |

Fig. 10

SUMMARY

1. A series of 100 operations for gastric ulceration in naval personnel has been reviewed and criteria for successful gastric surgery in wartime are proposed.
2. The operation of vagotomy and pyloroplasty was followed by ulceration or a state of failure in 42% of cases, and because it does not create a chemically-competent pyloric pouch with varying degrees of gastric extension. Reasons for this are advanced.
3. The technique of a Balfour-Bellith I gastrectomy with gastric distal anastomosis is described.

Discussion Following Paper

WALTER C. THOMAS, KILPATRICK. My last, but certainly not if there are, discussion on the most interesting and perhaps controversial paper which we have heard this afternoon. There is, there, and I am sure that much to go on with such to say regarding the discussion, so I will confine myself to a few brief points as I see them.

I share to a certain extent Commander White's view on the desirability of avoiding operations involving gastric jejunal anastomosis, although I believe that a well performed short loop anastomosis, particularly of the Polya type has brought in the emergency operative treatment of bleeding peptic ulcer. I am, even with this, however, not too confident that jejuno-J jejunostomy is preferable to a well conducted vagotomy with massive pylorotomy or pyloroplasty. I believe that the latter is a thoroughly sound operation, which not only avoids the difficulties of jejunostomy but is associated with rapid recovery and an early return to the level of fitness required by the Service man.

We have been shown some most interesting X-ray photographs, and diagrams demonstrating a narrowing of the gastric outlet following pyloroplasty and associated with a degree of gastric retention. I wonder if this apparent narrowing really matters. The purpose of drainage or suction of the pyloric bag is to permit the stomach to empty itself, and we know that this movement is effective. While rapid emptying may not be ideal, unless gastric retention and delayed pyloric relaxation are exceptionally rare following this operation. I feel that these appearances may be more of a radiological than a pathological phenomenon.

Some failure after meals may be noted by the patient following vagotomy and pyloroplasty, but at least he has a stomach which accepts and digests a large meal. Failure after meals is not uncommon after an adequate gastroscopy of any type, and many of these patients are unable to eat large and infrequent meals, a factor of some considerable importance in the Service man.

A balance must be struck between gastric retention and too rapid emptying. The latter is an undesirable state of affairs, and we have all had examples of the ordered digestion and absorption resulting from rapid gastric emptying after gastrectomy, and has often a diet made possible, in which one large amount has been consumed. It is very possible that Commander White's admirably planned limited shaped anastomosis may, in that kind of trouble of the kind?

The topic of duodenitis following vagotomy has, I believe, been over-stressed in my experience it is unusual and when it occurs is generally transient, and resolvable readily in simple measures.

REMARKS. The recurrence rate following total vagotomy and pyloroplasty compares favorably with that following jejunostomy, and must not be taken to be due to inadequate vagotomy using the median laparotomy. This can be corrected more readily by surgical means than can recurrence after jejunostomy. Recurrence when it occurs is usually early in the vagotomy case. When this due to the effects of gastric retention following cutting of the end of the pyloroplasty, one would I think expect it to occur later rather than earlier. It is, follow-up program

we had an increasing number of recurrences which can be shown to be due to the effects of gastric retention. Then I think our aim should be to produce an steadily increasing number of pyloroplasties rather than repeat the operations which in otherwise a highly satisfactory way.

Surgeon Lieutenant Commander J. BETHANCKEN. I would like to ask Surgeon Commander Watt how much extent of long incisions he has been following. Polya operations on the operation has been carried out on the Pyloric Antrum for many years. Recently are there not several technical difficulties involved in carrying out his procedure as I find it rather difficult to detach the gastric posterior wall distal to the pylorus and the fundus of the stomach and there is also a danger of damaging the Gallbladder Bile Duct.

Surgeon Commander J. WATT. Well I think I should say right away that I don't think the Billroth procedure is an easy procedure. I agree that there are difficulties and I think that it really ought to be done by the more experienced surgeon because of that. I agree too that there is difficulty in getting the duodenum off the pylorus in some patients with gastric ulcers. I think that most of us feel that the more gastroenterologists do the more often we have to leave behind. If you couldn't get the whole of the procedure of course you can leave it behind and carry out a Biering type of procedure with no anastomosis. Polya anastomosis. I would never have any hesitations if I thought the duodenum unnecessary because of too much absorption and waiting to do a polya gastrectomy but after all the object of my paper this afternoon was to look for an ideal output operation in the young patients the complications of which would be amongst others for such North Americans at sea and that was really what I was attempting to show of the modified Billroth I procedure. I did not suggest that it should be done in every case. However you may know that there are those who do Billroth quite frequently and it seems was published recently by Nyhlen and his colleagues who incidentally showed a recurrence rate for a straight Billroth I of 2 to 3 per cent a recurrence rate for vagotomy and pyloroplasty of 7 to 10 per cent and a recurrence rate for vagotomy and gastroenterostomy of 10 to 15 per cent. And of course the Billroth I operation is done much more frequently in the States than over here. They show rates even in the States that you could occasionally do a Billroth I procedure by using the gastric anastomosis in which the ulcer is dissected from within, the stomach is closed around the ulcer the ulcer is shaved off the pylorus and the duodenum is then detached free. They believe that this is a quite safe procedure and I think it is but again I would say that if there is any doubt about the feasibility of a Billroth then there are plenty of other procedures such as vagotomy and pyloroplasty which I am not very keen on or you may have, perhaps as a polya type gastroenterostomy.

Mr. J. A. SHEPHERD. Mr. Chairman I think all of us had with the same concern as Commander Watt is looking for for the best way under. You have shown operations in terms of the possibility of producing duodenal ulcers. I must say as a patient that I have never seen the following the operation (Billroth I) think it is to some extent a promise to produce. The second thing is, can you do it in, much easier and safer Polya operation for the gastric ulcer as an alternative.

in the ileal-jejunal operating table. Many oral, enteral, intragastric. . . Now, after three Sessions, we've got these very interesting and fascinating ileal-jejunal observations and as John Macpherson has asked, have you got to publish these cases? I think we have got an exaggerated idea of the frequency of them. I myself have followed up the observations which appeared after jejunectomy and in fact find that observations occurring after an enterostomy appear to be much commoner than observations related particularly to gastroenterostomy. I wouldn't tell myself that if you consent to see a man who has had a laparotomy of the kind, you would never, during the course of things and you would devote the operation on the same basis, and not worry too much about the risk of these very interesting but rare complications. One cannot get involved in the controversy between vagotomy and gastrojejunostomy, but I think it is worth remembering that vagotomy does not give long enough for us really to assess the effects. Personally, I advise your courage and after a while as you try to go back to a form of jejunectomy for the treatment of duodenal ulcer — I think you are probably right.

Doctor F. AVERY JONES: Mr. Chairman, I believe the position has changed too far in favour of vagotomy and I was particularly interested in hearing this paper. I must admit to slight bias against vagotomy. I don't like the idea of cutting a nerve which is 95 per cent efficient and only 10 per cent efficient. I think it is far more sensibly a bad principle. What I don't like, Sir, is the cases and the business of five, six, eight or nine hours in the emptying of the stomach which will occur regularly when you give food and barium to patients who have had vagotomy and pyloroplasty and who may be relatively free from symptoms or may develop some sort of discomfort. I think you may agree that this is bad and in the long run may have more serious effects. I am unhappy about the long term developments following a Polya gastrectomy and one is increasingly worried, particularly about the cases of colic and disturbance, nausea and weight loss, but one is a little bit glib about a Billroth I gastrectomy and I think particularly for the younger population. It does seem to be something that needs looking at further. The numbers here of course are very small, about 40, but the idea behind it, I would like to see applied to our very much.

Senator Captain E. H. MURCHISON: Sir, may I say extremely reluctantly that I have done over 800 Polya gastrectomies on small patients without meeting these dreadful complications and without any mortality.

Professor L. P. LE GUENEC: Mr. Chairman, Commander Watt considers a Billroth I procedure as a preferable procedure to the Polya, but I don't think it is true that you can clear up dumping in the majority of cases by conversion of a Polya to Billroth. The weight of evidence appears to show that the dumping syndrome and small intestine symptoms occur after any operation in which you destroy the normal mechanism for stomach emptying. It underlines in my mind the essential problem. We are operating on these people to rid them of acid secretion and we don't know any way of doing it at the moment without involving the mechanisms which control stomach emptying and I have become, in recent years, a thoroughly firm supporter of the operation of vagotomy. In the last five years I

have been very satisfied with the immediate results and I think I like to stress in proof that Doctor Ayres Jones made of the remarkably few deaths and the nature of the period gastroscopy in patients who have had them for 20 to 30 years. In the first 10 years the results are reasonably good and it may well be that regrowth is going to produce some symptoms for us in 20 years time.

Surgeon-Commander J. WATT: I should like to support that statement. It is the people who have had Polyp gastroscopies for ten or fifteen years or longer who begin to have trouble and I wonder whether it is because the stomach gradually hypertrophies and the stomachic loop of bowel attached to the stomach develops into an interstitial obstruction in the afferent or efferent end. The other thing that comes to happen is that in the neck of the distension the afferent and efferent loops approximate and there is a tendency for them to stick together and this is what one finds in some of these late cases where one does a sometimes a difficult 1 — at least that has been my experience — and I would say that those I have had to convert had all been quite satisfactory for the first five years or there had been their home to get symptoms.

Mr COLL WARELEY: Surgeon-Commander Watt, thank you very much.

SCOPE AND DIVERSITY IN NAVAL OPHTHALMOLOGICAL PRACTICE

By Surgeon Captain B. P. Grant, RN

It is a little privilege, it is, permitted to address you on this unique occasion. The subject which is described as "The Scope and Diversity of Naval Ophthalmology Practice" is assigned for me, by the Committee of the Symposium. This responsibility has again been assumed on my behalf my task becomes relatively easy.

Records of the early records of naval medicine do not reveal much evidence of special interest or achievement in the field of ophthalmology before the period of the wars against Napoleon. When one visits HMS Victory today and enters the surgeons' quarters lit by lamps of a century and a half ago, one inevitably has the doctor who able to identify the patient, let alone suggest the treatment of any type of lesion. The Napoleonic wars were fought as part in Egypt and the sieges of the ophthalmia contracted with the campaigns are well recorded. It was almost certainly a infectious disease complicated by secondary infection and such acute conditions were usually in certain areas of the Middle East so that they causing much misery and blindness. In the fourth volume of these work Napoleon and the Navy, Lloyd and Cochrane relate the distress, discomfort which took place in on on the French fleet ship *Raidier* and the *San Carlos* of Spain. The crews of the *San Carlos* were dying, of hunger and thirst and begged the *Raidier* for assistance. The reply came, to the effect that they could have what they needed, provided that they repaid the favour themselves so the *Raidier's* eyes were blinded by ophthalmia. By a terrible coincidence there was not a man with sufficient vision, any even on the *San Carlos* to carry out this life saving measure, and the ships ended up to the sound of mutual laughter.

John Briggs was the Surgeon in 1816's ship on the Eastern Mediterranean in 1821 when he went to Trieste, Trieste Physicians to the Hellenic Squadron. The letter which is contained in the *Notes of Medicine Maritime* deals with ophthalmia. Briggs asserts in it that the spread of the disease is by contagion the only one being passed on from man to man by infection from the eyes passed on by touch and give these details and so on. He states the view then held that it was caused by impure water, and not contagious ophthalmia, as it spread rapidly while his ship was far from land or vital and no matter which would do better. Unfortunately Trieste detected the letter as being treasonable, and detected Briggs as a rebel and expelled him while detaching his assistant towards the sick and wounded committed to hospital.

One cannot but feel sympathy for poor Briggs as his achievement was the first of a infection that contagion was the cause of the dissemination of trachoma. He did not get another appointment and died some years later on his pay. His record in the Admiralty goes on only the date of his appointments and contains no record of his service in the land but some fifty challenges which it is hard

was given (presumably) prophylactic doses of saltpetre (potassium nitrate) together with other types of plagues or trifles. In fact, there was no contagious outbreak either. In 1801 Lord Nelson consulted him about his left and right thighs, eyes which were affected by an eye infection, a vesicular ophthalmia and a membranous conjunctivitis, eventually spreading over the pupil. Trevelyan treated his patient by catheter of cold water and a few drops of saltpetre as a daily wash. Relief was rapid but incomplete.

Druggan received no recognition for his outstanding observations and his own temporary loss. Ryall seems to have been but little noticed by the Admiralty. He joined the Navy in 1789 having passed at the College of Surgeons in Ireland as Second Mate to First Mate. He was employed as the Physician of War Camp at Freetown where he must have seen many cases of ophthalmia, and in 1814 during a period of half pay he returned to Dublin where within a few weeks of his arrival the first eye hospital in Ireland was founded. There is some doubt as to whether the credit for this belongs to Ryall as a Doctor John Green Chalm had undertaken to effect this but had suddenly left Dublin being 'laid away in the consumption'. In 1819 Dr Tennison of the College of Surgeons in Ireland. Ryall himself did not possess these qualifications. Doctor Tennison, Large¹ has given much evidence in the records of this period and experience seems to have allowed his own representative. Ryall was undoubtedly the first ophthalmic surgeon in Ireland devoted entirely to his specialty. He did some useful work in connection with the prevention of ophthalmia in seamen and left Dublin suddenly to rejoin the Navy in 1820. He then served continuously until 1831 serving with the rank of Deputy Inspector-General. It is curious to read that during this period in 1816 the President of the College of Surgeons in Ireland was positively vigorously opposed attempts to acquire the standard of the examinations at Edinburgh, London and Dublin. Many obscure persons from all these parts returned from this country to Great Britain and obtained diplomas there and it can be proved in several instances that diplomas have been granted in London to persons of the description who had no knowledge of the medical profession ophthalmic medicine before.

In the period between the end of the Seven Years and the outbreak of the century 1816 there was room for ophthalmic specialists in the Royal Navy. Such appointments were made after a post graduate course in London usually lasting for three months and not all of the officers so selected proceeded to a post graduate diploma in ophthalmology. Their terms of reference and clinical responsibility were often limited by their lack of experience. The higher posts in administration were given to physicians and general surgeons so that ophthalmology was used as a stopgap, since to general surgery. It was applied as a part-time specialty and clinical side line and few ophthalmic men pursued its practice. The major ophthalmic operations were almost universally performed by the civilian ophthalmists. The only real contribution to ophthalmic knowledge made in the Service during the period was the work on colour perception at the Navy carried out by Mahalanobis Suman Mukherjee.

During the past fifteen years the situation has been completely transformed. There are sixteen ophthalmic specialists all of whom held post graduate diplomas and have been granted the grade of Consultant by an independent system which is

board. The out-patient attendance is three times a day. About 5,000 attending in the clinic alone each year. The ophthalmic department possess the equipment appropriate for all investigations and the usual major procedures of ophthalmic surgery are carried out in up to date facilities using modern equipment. Post-operative care is granted for periods up to 10 months as needed, suitable candidates is promoted to the Nigral Fellowship in Ophthalmology. Incapacitation is awarded, pending and eye hospital is provided. One of our number was privileged to be the Director of the Ophthalmic Hospital of St. John in Jerusalem for three years, while another has passed a year there as surgical registrar. A period of duty in such a hospital affords experience in ophthalmology which is quite unobtainable in the working community. One has the privilege to help in the relief of great suffering and distress, while at the same time witnessing some of the gross and imperiousness in the face of difficulty and threatened disaster which are common in the ophthalmic operating theatre. The three services are now working among ophthalmic surgeons in Jerusalem and there are other countries where their help would be accepted in mutual advantage. A happy personal recollection concerns a interestingly proud and concerned man, years ago who had bilateral dislocated lenses, and being in a remote part of China had resorted himself to blindness. A search of records previously revealed a possible diathermy apparatus. After some representation operation was feasible and was performed; the patient coming on returning for full clinical advice. The atmosphere of healthy understanding helped at both critical moments well replaced after operations the patient returning his blindness dependence to Rome.

The sporadic language of Naval nursing staff presents problems due to frequent discharging. A nursing sister or sick berth nurse rarely remains in a specific post for long. We have been able through the kindness of the Ministry of Health, Eye Hospital, to send nearly all our operating theatre nurses and some ward nurses for periods of training a development which has proved of immense value in promoting both interest and efficiency. The lot of any one in ophthalmology is any other study a man or woman must be heavily engaged in the work. A great personal delight is experienced in the kindness of our young specialists in the patient name. Much of this spirit we owe to the kindness and influence of our real and virtual, and other support with direct, connections whose warm help and advice in clinical and other professional matters, are invaluable to our progress. Our two home hospitals are now occupied for training for the Diploma in Ophthalmology.

Visual function has always been stressed in connection with entry to the Navy especially in the Examination or Entrance branch. The exacting requirements have caused the rejection of many desirable candidates while others have continued to pass the Selection test by means of artificial means from non-medical sources who charged considerable fees for their instructions. This money often poured in the further in the water; the patient finding himself involved after a short time with the frustration of a false start to life in an unprofitable age. This situation has been eased to some extent by the late age of entry entry and some relaxation in visual standards. Books could be written about this problem which is closely connected with an increase in the use of spectacles by teenage citizens and citizens while on

July. The United States Navy does not face this problem and provided most visual activity is obtainable with spectacles the service of persons is fully utilized. Clinical lenses look better on parade than spectacles, but they do not provide as yet an efficient substitute as regard to long term usefulness and so provide no real solution to this difficulty. Visual standards provide a support rather than a hindrance and every effort is made to avoid the loss of services on visual grounds alone of experienced trained men who have years of service still to offer.

The naval ophthalmologist is often reminded that upon symptoms which prove on careful assessment to have their roots in difficulties of an emotional or domestic nature. The patient will usually speak freely of his problems which often lead themselves to speedy adjustment either with or without the co-operation of our psychiatric colleagues. Each serious effort or injury when he reports to hospital is accompanied by a wallet containing the details of every occasion upon which he has sought medical advice and the results of all investigations on and out of hospital. This unique facility is invaluable in general assessment. The patient is also a seaman so that his movements are of his medical adviser's direction. He can be returned to hospital as required, report regularly for observation as directed and have his treatment carried out regularly outside hospital whilst responsible super- vision.

It is a commonly held supposition that the naval doctor, with only six months specially posted to sea from the age of 15 to 40 years. It is true that this idea was exploited. The naval hospitals receive the wives of acute and chronic persons and their children as well as acute personnel. The rack of life is thus an ordeal for observation and treatment. There are adequate facilities for full orthopaedic investigations at one period of life and for correct extraction of the other. The Navy has its own air clinic at the Fleet Air Arm and its own living in the Royal Corps of Marines so that the visual problems associated with aviation are performed as by naval medical officers at the Royal Air Force Establishment at Farnborough as well as on the Flying Personnel Research Committee. Research has been undertaken in connection with their problems as well as in underwater vision and chemical lesions of the external eye while further progress has whilst on submarines.

In conclusion it may be confidently affirmed that the Royal Navy offers a pre- sence and studying career to any medical officer of inclination who has a special interest in ophthalmology. The Royal Naval Hospital at Haslar alone caters for more than 6,000 ophthalmic out-patients each year and the total is steadily rising. The practice among young children and elderly personnel is increasing and the trend is certain to continue. It is noteworthy that in the United States Forebanks and Associates choose to have their medical attention in hospitals administered by the Navy or Army. The ship may not be the place where the first diagnosis of Glaucoma may be obtained in a fine United Services Hospital provided of course that there are close evidence of some Service connection and practice is appropriate, lifted from their medical practitioners.

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Surgeon Lieutenant-Commander A. J. RINTOUL, R.N., draws on his recent 'Voyage' on a cruise ship with his company on a civil life boat, built, almost 1000 years ago.

It is seldom, therefore, that one is able to see the various stages in the natural history of eye disease uncomplicated by therapeutics, to see the progress of disease such as trachoma, as John Brown must have seen them in the 14th, while leaving the blessing of a modern fully equipped hospital to deal with them.

I recently had the privilege of working for a year in the St. John Ophthalmic Hospital, Jerusalem, Jordan, through the kindness of the Directorate of the Order and the HMO of the Navy. As you can imagine there is no better place to study eye diseases in the Middle East, where Ophthalmology had its earliest beginnings among the ancient Egyptians 3000 years ago.

The Hospital in Jerusalem serves a very large part of the Middle East comprising 7 of the geographical divisions, from Beirut in the West to Mecca in the East. The bulk of eye disease is, of course, fully and two main groups, infectious and non-infectious diseases. Both of these are well spread, and aggravated by lack of water and a balanced diet which is the cause of the middle Eastern countries. A clear comparison can be drawn to the eye disease affecting ships of the last in the Nineteenth Century and also in the same category of today.

I would like to illustrate the later stages of eye disease in the absence of treatment I designed, of course, the last treatment remedies which would result of disease



Figure 1



Figure 2

and further developmentally tied mainly to the vision of the hand. My first experience with trachoma which affects almost 50 per cent of the population in some parts of India, East and at least 10 being the record up to date, is attributable to, and within, this frequency in Britain, usually in young people who have in fact been treated three times. Recently a young WELSH was admitted to RNS Hospital, Haver, with the typical clinical picture of early trachoma and I was able to show the various stages of the same.

Figure 1 shows the typical swelling of the upper eyelid conjunctiva of the later stages of the disease. It is the conjunctiva and a gathering of the conjunctiva



Figure 1

which causes so much discomfort. As a result of the swelling, there is a great deal of conjunctival secretion, the eye is sore and it is difficult to see the things which it is so often so difficult to see.

In a country such as India where the population is so large and so poor



Figure 2



FIG. 4. *Amphiprion lineatus* (young) and, again, 3 shows its *Amphiprion* parasite affixing the upper lid from which the black film infection was being obtained.

In spite of the terrifying appearance with early treatment the disease separates and much tissue loss can be remedied by judicious pruning as shown in Figure 5.

Among the more *Kribia* holders who have access to medical treatment (at a local silver nitrate shop) they have been told they have periods. Figure 5 shows the result of long-standing treatment with silver preparations—Aggravated—and it is easy to see the black deposit of residual silver in the sub-epithelial tissue. This is of course permanent.

Now we pass on to one of the great tragedies of Mobile Bay—the *Vitamin A* deficiency. This typically starts in the young class immediately after weaning and results in *Xerophthalmia* or Dry Eye. The hallmark in the earlier case is the black spot—white foamy patches of keratinized conjunctival epithelium—and keratinization of the corneal epithelium (Figures 6 and 7).



FIG. 6.

These changes are reversible and Figure 8 shows the same child about five weeks later after treatment with intramuscular Vitamin A. The keratinized epithelium has been shed. The growth of hair on the face, the evidence of additional delta rays is still present.



Figure 7



Figure 8

Severe, and exacerbated Vitamin A deficiency may have been and usually. The test is a dry eye (Figure 9) with keratinization of the cornea and conjunctiva. The second and more common result is a marked thickening of the corneal epithelium, perforation of the cornea with air leakage and the formation of an inverted Descemet's membrane as shown in Figure 10. This will eventually result with threat of the individual passing and as time life produces rhinopharyngeal tumor.



Figure 10



Figure 11



Figure 12



Figure 13

Figure 10 shows a myeloid mass on the cornea. This was not excised because of the known recurrence.

Figure 11 shows one of the eyes with a myeloid mass on the cornea protruding through the iris. A mass of myeloma in the retrobulbar space had just been removed by the patient's eye doctor.

Figure 12 shows that in patients with myeloma, choroidal metastases are very common. Figure 13 shows a small intestine (in the retrobulbar space) penetrating the choroid which has been maintained in a position of about normal elevation by the stretching action of myeloma in the retrobulbar space.

Figure 14 shows the 8-year-old child, whose parents were killed together by the Knights of St John, under which it carries a picture of the man.



Figure 14



Figure 15

Discusses Following Pages

Mr WILLIAMSON NOBLE: First of all I would like to say that a great deal of progress has been made in ophthalmology in the West. This, of course, I have seen in India over the years in visiting and they hardly ever need kymographs now. I can remember some attempts at establishing ophthalmology earlier but then I remember being appointed to the Hospital, in 1915 to a Hospital Assistant and the fact they had a complete set of surgical instruments for external extraction attempts to cataracts. I have never been able to understand why but then it was because no one there knew anything about it in general practice. There was FMO who had just managed to see through an ophthalmoscope and when he was going over the day's case I don't care what you tell him. You never seen anything

through an ophthalmoscope in my life. Well that's all been changed now and I estimate a great deal of it is due to the activity of Surgeon Captain Grant.

Chairman: MR. COLL WARDLEY: I would like to thank Surgeon Captain Grant for giving a very interesting discussion on the way in which ophthalmology has progressed in the Service. I will remember when I was appointed to the Scarborough Hospital ship in 1914. I was supposed not only to do general surgery but ophthalmology as well. I suppose that was due to the fact I put down on my entrance form that I had been an Ophthalmic House Surgeon, but after one year I failed miserably and we eventually on the *Cornby Castle* got Mr. Fyvie to come along and take over the ophthalmology, which was a great thing. But it was interesting because Mr. Wilkinson Noble was in the ship when I was. I suppose he could have come over and done the work very well indeed for us, but we didn't know that at the time.

Thank you all very much indeed for coming along to this Symposium. I think it has been very well worth while and I would like to congratulate the medical officers of the Navy who made this such a highly polished performance.

Summer 1946 proceedings

Sessions III

Evening

Chairman: Professor E. W. Donald

Chairman: Professor E. W. DONALD: It is a very great honor to be asked to Chair this Symposium. I have many friends in the audience, and I do, I hope, permit me having been a Common Believer, Royal Naval Medical Officer myself.

I would like to mention the death of Sir Robert Dixon, who was a great friend of the Navy. I know we would all like to pay tribute to this very great man whose contributions made so many new things possible and saved many lives.

It now gives the great pleasure to introduce Vice Admiral Mackenzie, who is going to talk about 'Some Thoughts on the Nuclear Navy of the Future'.

SOME THOUGHTS ON THE NUCLEAR NAVY OF THE FUTURE

By Vice-Admiral B. S. Mackenzie

Professor Donald, Ladies and Gentlemen: I feel very privileged to be here today and I am grateful to you for having the opportunity to give you my thoughts on the Nuclear Navy of the Future.

I dare say there will come some people who would consider the title of my talk more appropriate for All Fools' Day — in that respect I am grateful for being asked to open the talking today and say yesterday.

I should make it clear at the outset that 'Some thoughts on the Nuclear Navy of the Future' are my own personal views and that what I say does not necessarily reflect the official policy in the Ministry of Defence, the Admiralty, the Admiralty — through of course in some cases we are in agreement.

One further point — the expression 'Nuclear Navy' does not embrace in any way the presence or use of Nuclear Weapons, it refers solely to the use of Nuclear Power, as provided by Atomic Reactors, for the propulsion of ships.

ADVENT OF NUCLEAR POWER

Before we look into the future we should take a glance at the past and see what has happened in the past 20 years. For I think, it can be agreed that Nuclear Power became a practical though very expensive proposition about the end of World War II in 1945.

It is pointed out going to a true submarine as opposed to the submarine which had suffered failure in all respects was quickly recognized and by 1947 the Naval

speed (eg. 120,000 miles an hour) and power) to present-day ships and the elimination of torpedo and homing missile launching, storage problems against the danger of enemy fall-out.

No far' all I have mentioned relates to warships. A point will be accepted that the use of nuclear power in merchant ships is not yet an economic proposition and it is not therefore commercially attractive.

Future developments may well make it so however and it is noticeable that the US already have a nuclear powered merchant ship, the *Freedom* and that Japan and Germany are each building one.

FUTURE DEVELOPMENTS

As you will have gathered we have lagged far behind the other major naval powers in the building of nuclear submarines, but there is already a radical improvement in the rate of construction of these and as their unique qualities are proved as this I believe we shall see that trend improving. Not only does it seem certain that the nuclear powered hunter/killer submarine will prove the most effective and substantial vessel of the future, but the message of nuclear propulsion in the economic power of the battleship, steadily has grown to a distant weapon system so the utterly unkillable, and which is certainly the most effective protection to men. Here we have a submarine of some 5,000 tons, about 400 feet in length bigger than many jet-war cruisers. And no balance problems or stability unknowns in her operation. All this goes to show I believe that there is no yet much untapped potential in a warship as the nuclear powered submarine and that many developments are yet possible. — And indeed these will be based upon us if we don't look ahead and accept that voluntarily.

For this reason (I am happy enough) I would like to draw your attention to Japan. We all know that any sort of satellite, manned or unmanned, can be put into orbit, the particular one, the concern one at the moment is the reconnaissance satellite or 'eye in the sky'. There is no reason why in future fleets of mine or missile vehicles the sky should not be full of these satellites all putting back to earth regular and reliable reports giving precise details of the movements of all surface shipping on all the coasts of the globe. Thus gone are the days when a ship or a fleet could hide in the wide open expanses of the ocean thus preserving not only its own safety but the element of surprise so vital in war.

To relieve the situation to remove enemies from sight in the sky whilst it was there is only one thing to do and that is to travel underwater — and only the nuclear submarine can do this satisfactorily.

Taking account of all these factors it seems clear that we should expect a very considerable expansion in the use of nuclear propulsion in a ships, particularly submarines, and that we may have operational fleets of the latter. Some types are already unkillable *Freddies* and could include

- a. the capital ship of the future a vessel with a mixed bag of missiles
- b. the escort of the future
- c. the troop carrier — a submarine the use of our Polaris boats could carry

- about 200 troops and their equipment. I THINK amphibious vehicles and a fleet of motorized rubber dinghies.
- d. and even maybe it is not beyond the bounds of possibility to have the next carrier of the future — a Nuclear Submarine equipped with VTOL aircraft.
- And that, of course, we should expect deeper diving submarines.

ASSOCIATED PROBLEMS

Naturally any such developments will bring problems in their train. Science and technology will solve the purely technical ones, but there will be others of more direct concern to you here this morning. For example, The way in which safe nuclear war going to live in a possible circumstance, something we had had in the past for a very small percentage of our Naval Manpower, but it is going to affect a much greater proportion in the future, if they are given a proper aim and object and sense of purpose. This may present its greatest difficulties than ensuring our surface ships has done, but it is possible that we may need some special form of education of Personnel.

Next, Nuclear Health Physics and Atmosphere Control are obviously going to be of the greatest importance, and the Medical Officers and staff in these submarines will have to be specially trained in these subjects. Again, when it comes these ports or dockyards for maintenance or refit, particularly if work is required on their nuclear power plants, there must be effective systems for strict Radio Isotopic Control and Protection, which will require the necessary specialists. And last of all, with deeper diving submarines we must try to improve our methods of escape from greater depths.

CONCLUSION

To sum up, I have tried to suggest to you that in the future — and here I'm thinking of the remaining years of this century — there will be a marked increase in the use of Nuclear Propulsion in HM Ships. This will be primarily in the submarine field but Surface Ships also will be affected. The operational advantages of warships which need to re-fuel every few years instead of every few weeks are tremendous, so this are the advantages of being able to go under water with out loss of endurance or speed. Should these developments come about — and I personally am convinced they will — then there will be opened up new fields in which the support of Naval Medicine will be as vital as ever if our ships of the future are to maintain their operational efficiency.

Professor DONALD: Thank you Vice Admiral Mackenzie for that valuable account.

THE NAVAL RADIOLOGICAL PROTECTION SERVICE

By Surgeon Lieutenant-Commander D. Malcolm Ashery, RN

I would like to describe to you the organisation which is being set up at the Royal Naval Medical School, Aldershot in order that adequate protection is given to personnel of the Navy department — both uniformed and civilian — from the hazards of ionising radiation. The organisation is called the Naval Radiological Protection Service.

Ionising radiation is being used increasingly in the Navy for a variety of functions — and some of these are shown in Table I.

Table I
Sources of Ionising Radiation in the Navy

| | |
|---------------------------|---------------------------------------------------------------------------------------|
| 1. Propulsion | Submarine reactors |
| 2. Training | Training Reactors Small sealed and unsealed radioactive sources |
| 3. Radiography | (a) Industrial — large sealed gamma sources X-ray unit (b) Medical — X-ray unit |
| 4. Research | Sealed and unsealed sources X-ray crystallography and spectrometry |
| 5. Luminating | Paint containing radium or tritium |
| 6. Instrument Calibration | Sealed sources |

At present HMS Dryadburgh is our only operational nuclear submarine, but by 1968 it is planned that we should have seven further at sea — three Hunter Killer Submarines and four Polaris. It is worth noting that at that time, we shall be responsible for the safety of as many reactors as the Central Electricity Generating Board.

There are two training reactors. Jason is the Royal Naval College at Greenwich and the Submarine training reactor at the Admiralty Research Test Establishment at Gosport, Portsmouth.

Sealed sources refer to radiometers which are sealed within an envelope of non-radioactive material. They are used as standard radiation sources.

Unsealed sources are those in which the radionuclide is in chemical or bio-chemical form. These may present an external radiation hazard or worse will may be ingested or inhaled as they are unsealed and penetrate the body tissues from within.

Industrial radiography is carried on extensively for the inspection of cracks, welds, logical failures in castings and in structures. Because of the density of the materials often high energy gamma radiations have to be used for adequate radiographs.

The ionising industry has for many years used a mixture of radium and zinc sulphide for its luminous paint — and it has not used several workers in the industry died from leukaemia disease that the harmful of this material source of radiation were appreciated. Radium is now being replaced by tritium — an isotope of hydrogen — which is relatively much less harmful.

It can be seen from the table that radiating sources of greatly different magnitudes are used in the Navy, ranging from several thousands of curies in the submarine reactor to a few microcuries in laboratory work. The intensity may be of alpha, beta, X gamma or neutron radiation.

It is our aim at the RM Medical School to set up a comprehensive organisation which will cover all the safety aspects connected with the use of these radioactive sources as laid down by Defence Council Instructions. And here I should add that we have the added responsibility to protect members of the general public from any accidental release of radioactivity or radiation.

Table II

Functions of the Naval Radiological Protection Service I

Health Physics

Photodensitometry and Aqueous Radiation Records Centre
General Monitoring
Whole Body Counting
Bioassay
Surveys of a Working Environment
Indices of General Environment

Medical and Biological

Reference to Diagnosis and Clinical Research
Radiobiological Research

There will be four subdivisions in the Naval Radiological Protection Service, under the title, Health Physics, Medical and Biological, Administration, and Training. The departments will work closely together in much of the equipment that is being installed in the Medical School will be common to all.

This organisation is fortunate in having its planning and administration under the same roof as its technical laboratories, in this respect it is unique (and the aim of the Radiological Protection organisation of other government departments).

The responsibilities of the Naval Radiological Protection Service are shown in the Tables 2 and 3.

Table III

Functions of the Naval Radiological Protection Service 1

Administration

- Inspection
- Safety Assessments
- Information and Library Service
- Investigation of Contingencies

Training

- Medical Officers
- Sick Berth Ratings

For nuclear submarines

- Radiation Safety Personnel

The **Admiralty Radiation Research Centre** has, since being opened, for several months and its function is to keep a permanent medical legal record of the personal radiation dose accrued by Navy Department personnel. Like the war it will be runned by the **Photoluminescence Service** which will develop the personal monitoring film and insert the radiation doses for the Records Centre. This latter service is at present situated out by the Ministry of Health and MRC Radiological Protection Service at Sutton Surrey. At the Medical School a new automatic system will operate and the data will be processed by the Portsmouth Dockyard computer.

General monitoring will be performed by the new laboratories at the Medical School which were completed at the end of last year. (Figure 1 shows the situated of one of the new laboratories).

The **Whole Body Counter** which despite its name is not a device for keeping a tally on able bodied seamen in the Navy, is a sensitive instrument used for measuring small quantities of radionuclides in the body after accidental contamination of the body or as part of medical investigations. It can four large single crystals of sodium iodide as scintillation detectors distributed by a shield of six inch steel.

Excretion covers the measurement of radioactivity in excreta — which often provides the only data on the rates of elimination of radionuclides from the body.

The staff of the Naval Radiological Protection Service will survey marine areas in which radioactivity is used and also will survey the land masses and littoral surroundings in the vicinity of nuclear operations.

As the Naval Radiological Protection Service will be staffed by Naval Medical Officers, Warshipmen and Sick Berth ratings, as well as Civilian Scientists it is our hope in the near future to set up a **Chemical Ratings Unit** which will work closely with the Naval Hospital at Haslar, a few miles away and perhaps also provide an



Figure 1

telescope screen to confirm hospital of the Women's Regional Board. We hope also to be able to verify our findings with *Radioisotope Research*.

Our radioisotope department will be responsible for the lectures listed in table 3, which are all explanatory. I should like to emphasize that we feel that a proper history and explanation are very important in this subject which contains many scientific disciplines. It is essential for those persons working in this and related radioisotope laboratories.

Finally we have the job to teach Health Physics to those who will be responsible for radiation safety in the Nuclear Submarine — Medical Officers and ratings — and in *Workshops* and other personnel and civilian personnel who have similar duties in ships and shore establishments.

Discussion Following Paper

Prof. DONALD: May I have a quick word before my name is? The danger of loss of specialized personnel to industry must be great after such training.

Surgeon Lieutenant Commander D. M. ACHARY: Yes that is very true. But, particularly from the point of view of the personnel concerned with electronic equipment. In fact as far as the Health Physics side is concerned, we have been recruiting personnel from industry.

Surgeon Captain FRASER: My Chairman. There is one little point in Nuclear Medicine on the Navy. It has a very high glamour rating now and I think if we're not careful we shall go into more shallow sample clinical research and we have had in the past a few sharp words between the Medical School and ourselves because we are tending to lose personnel. I think clinical research is a more important thing and we are now pushing this in the hospitals, but we must have a certain amount of auxiliary help and I think we discuss when we allocate technical personnel we should not forget the poor clinician in hospital.

to the central and peripheral receptors and that the resultant translation to a function of them all be constrained on the way in which the known elements were combined.

Dwyer's theory can be shown graphically as in Fig. 1 which is a plot of the expected translation (PT) against the absolute partial pressure of carbon dioxide (P_{CO_2}). Gray concluded that there was a linear relationship between P_{CO_2} and P_{O_2} and further that the effects of P_{CO_2} and hydrogen ion concentration were independent and additive. The effect of and is not shown in this figure, but both these predictions appear to have been validated by subsequent work.

Gray further concluded that the effect of hydrogen would also be independent and additive as is shown in Fig. 1 so that as the absolute partial pressure of oxygen (P_{O_2}) is lowered you would get a family of nearly parallel lines showing the response of PT to P_{CO_2} at various constant values of P_{O_2} .

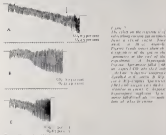


Fig. 2 shows the results of an experiment performed by Douglas at Oxford (1948) and is of the quantitative tracing of baroreflexes from a closed system. In

the top tracing (A) the system was filled with air to start with and a scale from CO₂ absorbance was present so that the hyperpnea of hypoxia with a falling P₅₀ is seen. In the middle tracing (B) the apparatus was filled with oxygen and had no CO₂ absorbance circuit, and demonstrates the ventilatory response to increasing hypoxemia without hypoxia. The tracing ended when the subject could no longer tolerate the hypoxemia, and analysis of the gas remaining in the system at the end showed a CO₂ of 0.7%. The hyperpnea was much greater than that due to hypoxia, even though at the end of the first tracing the oxygen was down to 4.5% and I should think that the subject was nearly passing out. The bottom trace (C) shows what happened when the apparatus started filled with air and without absorption of CO₂ so that the subject experienced the combined effects of hypercapnia and hypoxia. This time the termination was much quicker than in either of the other traces and the hyperpnea at the termination was definitely greater than when only one stimulus was present, indeed the momentary ventilation far exceeded the sum of the increments seen after the same period of exposure to the other two experiments when the two stimuli were applied separately.



Figure 2. Relationship between P₅₀ (mm Hg) and R_v (l/min) at three levels of P₅₀ (mm Hg): (A) 40; (B) 45; (C) 50.

Hutton and Smith (1912) published the results of experiments in which they measured the ventilation of their subjects while varying the P_{ACO_2} , but keeping the $P_{A_{O_2}}$ constant.

Fig. 3 shows their findings with V_E plotted against P_{ACO_2} at four different levels of $P_{A_{O_2}}$. There is a linear relationship between V_E and P_{ACO_2} , at least over the upper part of the curve, but these lines are not parallel as being expected (cf. Fig. 2). Increasing $P_{A_{O_2}}$ definitely increases the slope of the lines showing that hypoxia is not simply additive but multiplies the effect of increasing P_{ACO_2} .

The linear relationship between V_E and P_{ACO_2} breaks down at a level of P_{ACO_2} that Hutton and Smith called the threshold value below which the response curves become more horizontal and are called the 'dipleg' part of the curves. Presumably the normal resting position on the curve of voluntary breathing air is just above the threshold value and the upper linear part of the response curve is only met with in normal life in conditions of hypoxia. However it is easier to increase response along the linear part of the curve than along the dipleg, so

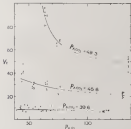


Figure 2. Breath above $P_{A_{O_2}}$ (top) (left), $P_{A_{O_2}}$ (bars) (columns) at three values of $P_{A_{O_2}}$ (bars) referred to Figure 1. $P_{A_{O_2}}$ the values 3.2, 4.5 and 5.8 mmHg; curves for the points in brackets, which were also

most of the work on the aspect of respiration has been done by giving subjects out to breathe containing an increased partial pressure of CO_2 .

Connaghan and Lloyd and their co-workers at Oxford had been working along similar lines. Fig. 4 shows the results of some of their earlier work (Gaz. 1949; Connaghan, Connaghan & Gas, 1957) with \dot{V}_E plotted against P_{ACO_2} , the term $\dot{V}_E/P_{\text{ACO}_2}$ constant, and shows the same results as Nadelson and Smith in that increasing the P_{ACO_2} definitely increases the effect of hypoxia.

Fig. 5 is an imitation of Nadelson and Smith's well-known approach (cf. Fig. 7) with \dot{V}_E plotted against P_{ACO_2} and shows the typical result of an experiment in

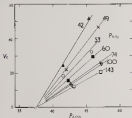


Figure 2. Plot of \dot{V}_E (P_{ACO_2} constant) (see $\dot{V}_E/P_{\text{ACO}_2}$ (ml/min/mm Hg)) (P_{ACO_2} (mm Hg)) ($\dot{V}_E/P_{\text{ACO}_2}$ (ml/min/mm Hg)) (P_{ACO_2} (mm Hg)) ($\dot{V}_E/P_{\text{ACO}_2}$ (ml/min/mm Hg))

determining the CO_2 response curves at different levels of P_{ACO_2} . As the P_{ACO_2} is decreased the slope of the response curve increases and a line of best fit is obtained. In this figure the upper portions of the curves have been omitted and two of the lines have been extrapolated to cut the P_{ACO_2} axis. As can be seen these lines tend to come to a common intercept on the P_{ACO_2} axis and if we add this intercept to the relation between \dot{V}_E and P_{ACO_2} , at any single value of P_{ACO_2} can be described by the equation

$$\dot{V}_E = 5.4 P_{\text{ACO}_2} - 74 \quad (1)$$

where S is the slope of the response line and B is the value of the intercept on the P_0/G_0 axis. (Lloyd-Jones and Cunningham 1968)

It has been repeatedly confirmed that hypoxia does not in general alter B but exerts its influence on S , although in individual experiments this is not always apparent.

If the slope of the response curve is plotted against the P_0/G_0 hypothesis is produced describing the inverse relation between the two, as is shown in plot (d) of Fig. 5. A curve of this shape can be defined by knowing the values of the two

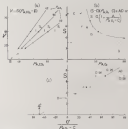


FIGURE 5. (a) Plot of S versus P_0/G_0 and (b) of the S versus P_0/G_0 of equation (1) ($P_0/G_0 = 0.075 P_0/G_0 + 0.01$) against (c) at other values of P_0/G_0 ($S = 0.075 P_0/G_0$) and (d) against (b) ($S = 0.075 P_0/G_0 / (1 + 0.075 P_0/G_0)$). The theoretical curve is shown graphically as a solid line. Data points are open circles. (a) S versus P_0/G_0 is shown in (b) ($P_0/G_0 = 0.075 P_0/G_0 + 0.01$) and (c) ($P_0/G_0 = 0.075 P_0/G_0$). (b) S versus P_0/G_0 is shown in (d) ($P_0/G_0 = 0.075 P_0/G_0 / (1 + 0.075 P_0/G_0)$). (c) S versus P_0/G_0 is shown in (d) ($P_0/G_0 = 0.075 P_0/G_0$). (d) S versus P_0/G_0 is shown in (d) ($P_0/G_0 = 0.075 P_0/G_0 / (1 + 0.075 P_0/G_0)$). The theoretical curve is shown graphically as a solid line. Data points are open circles.

asymptotes C and D and the area constant AD , where A is the amount by which the P_0/G_0 exceeds C at the point on the curve, where the slope S is unity (D

One of the asymptotic expressions that give P_{50} and D is usually $C = 30 + 0.05 P_{50}$ or

$$C = D [1 + A/(P_{50} - 1.4)] \quad (2)$$

The asymptotic value D is the real slope or the slope of the P_{50} - P_{50} line in the complete absence of hypoxia; its value is generally about four times of that found at the normal P_{50} , of ca. 180 torr. The other asymptotic value C normally has a value of about 30 torr O_2 . As P_{50} falls towards this normal value the slope of the P_{50} - P_{50} line approaches infinity and the subject becomes as highly sensitive to hypoxia. Other critical P_{50} in this region are known from an arterial P_{50} of 25 torr is usually regarded as the limit for consciousness to man and in dogs it is reported that serious damage to the brain occurs at about 1 P_{50} of 10 torr on the same side of the cerebral vasculature. Therefore to try the estimate of C are obtained by extrapolation from data at higher P_{50} . The constant, of the hyperbola, varies from one subject to another and is defined by the parameter A , which can be regarded as expressing the hypoxia sensitivity.

The parameters A , C & D can be obtained directly from the hyperbola of enough points are available and then, in a computer handy or $k-d$ with data, or they can be calculated by the method shown in 1/1 of Fig 4. 5 is plotted against $10^3/(P_{50} - C)$ using real values of C and the straight line is obtained. For example Fig 4. 1c shows the difference lines, produced by using values of $C = 20, 25$ and 30 . When the straight line has been obtained the vertical intercept equals D (the horizontal asymptote or zero slope in Fig 4. 1d) and its slope is the product of A & D . The horizontal intercept equals $-10^3/A$, so taking the reciprocal of this gives an alternative method of evaluating the hypoxia sensitivity parameter A .

Equations (1) and (2) can now be combined to express the overall response of ventilation to CO_2 and O_2

$$V = D [1 + A_1(P_{50} - C)]/a^2(P_{50} - C) \quad (3)$$

The expression in the first bracket represents the combined effect of P_{50} and arterial hypoxemia on concentration and can be expanded further. Average values of the parameters are listed below, \pm their standard deviations (Crouthampt-Smith and Lloyd 1966)

| | | | |
|-----|------|-------|--------------------------|
| n | 10.1 | \pm | 1.8 torr CO_2 |
| A | 86.7 | \pm | 11.4 torr O_2 |
| C | 32.1 | \pm | 7.6 torr O_2 |
| D | 348 | \pm | 175.4 ml/min/torr CO_2 |

The equation and the determination of its parameters has been used to study the changes in ventilation that occur under various conditions.

Fig 7 shows what happens when the real base state of a subject is changed (Crouthampt-Smith, Ligny and Lloyd 1980). On the right of the figure is the line of base obtained under normal conditions. If the output is now made random by inspiring atmospheric air alone and the CO_2 response curves are re-determined,

it is found that the whole has been shifted to the left, i.e. the parameter B (the P -axis intercept) has been reduced. In addition, the P -axis probably moves, the other being

If the slopes of the lines are plotted against their P -axis intercepts for both these cases, as in Fig. 5, the hypothesis based on the points for one case fits those for the other

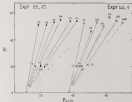


Figure 5. B vs. P -axis intercept for (1) non-drowsy and (2) drowsy (as in case of Fig. 3) (Expt 65, 10) and (3) non-drowsy and (4) drowsy (as in case of Fig. 3) (Expt 65, 4). The lines represent the hypothesis that the P -axis intercept is the same for both cases, and the slopes are different. The lines are drawn through the points for one case, and the points for the other case are plotted on the same lines.

showing that there is very little difference between the parameters A , C & D in the two conditions.

The change that occurs when the subject is subjected with non-drowsiness is shown in Fig. 5 (Hey, unpublished). The figure summarizes the results of several experiments so there is a lot of scatter, but the trend is for an increased slope with non-drowsiness for the same P -axis, and there is very little if any change in B . If the slopes of the P -axis lines are determined at various values of P , the other parameters can be worked out as in Fig. 3 (Conway, Hey, Patrick, and Lloyd, 1963). It can be seen that there is very little alteration in (2) the vertical intercept, but the value of A calculated from the horizontal intercepts shows about a seven-fold increase with non-drowsiness in this case. As the parameter B represents the rate slope this experiment implies that non-drowsiness would have no

effect on respiration in the absence of hypoxia, and this conclusion has subsequently verified (Christopherson, Lloyd and Planch, 1966).

This approach has also been used to determine the effect on respiration of increased body temperature (Elstner, 1968). Fig. 11 shows the boundary lines, the top one being at normal body temperature, and the bottom one raised about 0.5°C. There is possibly a small change in R_0 but the obvious change is in the slopes of the lines. The whole fan looks as if it had been folded up from the right, showing an increase in D .

In all of the above figures, except Fig. 3, the degree position of the response curve has been omitted. This was mainly because it was not necessary in the calculation of the parameters, but also because not sufficient is known about the degree to be, it is with these calculations as it is very difficult to obtain good experimental results from the part of the response curve. Fig. 12 (left) unpublished displays

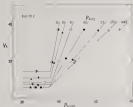


Figure 11. P_FO_2 from 0.05 to 1.0 atm, fixed at a constant a (using constant values b_1 , P_{FO_2} at 0.1) subjected to constant changing a given b_2 arrangement of the values a or b_2 of the part of the curve. The total respiration of the $C. P. M. 2$.

the results of some experiments performed a few years ago and shows that the degree starts at an increasing level of ventilation as the P_FO_2 is decreased. As there are so few points following the curves, it was not possible, in the constant about the shape of the degree, and the figure shows only one of the arrangements that could fit the data.

I have been able to show clearly that there is very probably a slope on the display. It is not horizontal as is shown in Fig. 12 but has a slight positive slope which is however much less than that of the upper part of the curve. This shows that there is probably still some sensitivity to P_{CO_2} in this region. The presence of a slope on the display is of interest in the study of acclimatization to altitude but much more work requires to be done. Also of course, relations are certainly on the display and physiologically in an altitudinal condition, hypoxic and hypoxic-sapient, and these cerebral vasodilations could be to some extent reduced by the low P_{CO_2} so that it is a very real area of research.

The transition from the flat to the steep part of the \dot{V}_{CO_2} -response curve in hypoxia is usually depicted as occurring sharply at a single P_{aCO_2} (cf. Figs. 3 and 12). It would be surprising if this were actually the case since it would require that both the central and the peripheral chemoreceptors should become active at a single value of arterial P_{CO_2} , and I have some evidence that this is not so. In a couple of experiments I have obtained a three-part curve consisting of the slightly sloping display, then a short line of greater slope, and then the steeply sloping upper linear part of the curve. Lacking though the literature there are hints in many papers that this has sometimes been seen by others (Bland and Ralston, 1955).

There may be a separation of the responses of the central and peripheral group lines, or possibly separation of the response to carbon dioxide from that of acid and different methods are being tried to approximate the separation.

SUMMARY

The chemical control of respiration depends upon the partial pressures of carbon dioxide and oxygen and the hydrogen ion concentration of the blood. The effects on ventilation of carbon dioxide and hydrogen ion are independent and additive but the effect of hypoxia is multiplicative. There is a linear relationship between ventilation and P_{aO_2} over the upper part of the response curve above a threshold value of P_{aO_2} . The relationship between ventilation and the chemical stimuli over the linear part of the response curve can be described by the equation

$$\dot{V} = D(1 + A/P_{aO_2} + C/P_{aCO_2} - C_0/P_{aCO_2} - M)$$

The equation and the determination of its parameters have been used to investigate the changes in ventilation that occur under various conditions such as alteration of the partial water state of the body, alteration of body temperature and release of acclimatization.

Research is in progress to determine the shape of the carbon dioxide response curve below the threshold value of P_{aO_2} as a test of importance in hypoxia and in the study of altitude acclimatization.

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DISCUSSION FOLLOWING PAPER

Professor DONALD: The number of respiratory volumes are of the greatest importance in physiological work. The computing of the ventilation required is carried out by many complex systems in the body. We are beginning to realize that the knowledge of the \dot{V}_{TI} , \dot{V}_{D} and \dot{V}_{E} is the only real blood, cerebral, spinal fluid and relevant resources would still only give us a crude idea of the total ventilating situation. I would like to emphasize that although even at the early stage of knowledge the matter seems extremely complex that it is only by controlled observations, careful records and the testing of hypotheses that we will make any further advance.

Again, lack of knowledge of ventilatory behaviour in human service conditions (occupational breathing apparatus, high pressures, with variable gaseous environment) has already and is now in the Royal Navy and this is an increasingly important service problem.

Sergeon Lieutenant-Commander YOUNG: I must emphasize that these papers have not put forward an smoking hypothesis. They are not explicitly believed to and may always be changed in the light of new discoveries.

Professor BARNARD: I was going to say that if a young research worker comes to the laboratory or clinic and says he would like to solve the respiratory problem I would give him a laboratory, some money and my admiration!

Thank you very much. Surgeon Lieutenant-Commander Young: Now we must get on to the next paper. In fact it is that short.

MEDICAL PROBLEMS OF VERY DEEP DIVING

By Surgeon Lieutenant-Commander E. E. P. Barnard, MD

Anyone who has done any diving today or yesterday will realize that even diving is carried out in the sub-surface zone where sufficient water pressure is available for breathing, and preferably also in warm clear water. The type of diving involved in Deep Diving has concerned with all the discomforts of cold dark waters as well as its own peculiar problems.

The area covered by the term Deep Diving is in the present context, that which has been explored as yet only experimentally in pressure chambers and lies between 200 and 1000 feet for durations up to 4 hours at depth.

Two medical problems which are of particular significance to a doctor are those of isolation and communication. Since the divers are contained within the thick steel shell of a pressure chamber, the two main channels for information as in these conditions are observation through small viewing ports and speech through a two-way communication link. Observation rather than direct transmission and hearing taking is interfered with by the distortion of the voice under pressure which when breathing helium at 500 feet makes the divers completely unintelligible. Although they can hear and understand spoken questions answers have to be obtained by sign language. The only way round these difficulties is for the medical officer to be locked into the chamber when he becomes a diver himself, exposed to the same hazards and limitations.

The major problem in diving is still the prevention of decompression sickness. The first successful diving tables were produced by Professor I. S. Haldane in 1887 and they are still today today a table based on his method of calculation. Tables produced by William Boylston of a series of steps which roughly follow an exposure will come back to the surface. If, as an example, one takes the table for a dive to 100 feet, which involves about 90 minutes decompression by allowing the table scale to find decompression from 100 feet takes 4 to 10 hours, one could equally well represent the shape of a tangent curve. In other words the solution to the problem of preventing decompression sickness, and of timing it, appear to have the same form but a different time scale.

Since diving tables are now nearly 60 years old a man is wondered why decompression sickness still presents any problems. Haldane noticed that a drop in pressure from 3 Atmospheres Absolute to 1 Atm Abs. was safe, and assumed that it would be just as safe to drop from 5 Atm Abs. to 3 Atm Abs. which represents the same decompression ratio of 2:1. However, he realized that there were no evidence for dives deeper than this and in fact a has been found when using oxygen tables that the safe decompression ratio becomes actually reduced with increase in depth. The time rate to the surface being of the order of 7:1 which at 500 feet is reduced to about 3:1. The first limitation of the old table method is then that the decompression ratio is not constant but alters

with depth. The second limitation is that the Haldane method provides for only one stop, the first stop, is only for a particular depth and after a certain time it is considered safe to ascend to a second stop and so on to the surface. There is reason to believe that this is an over-simplification and that there are many possible ways back to the surface.

In some decompression experiments which we have carried out in the Royal Naval Physiological Laboratory using guinea pigs, all animals were given a standard dive of 40 minutes at 200 feet breathing air. The first stop was either at 50 feet, 60 feet or 70 feet and the decompression was split into one, two or four stops. In spite of the very different forms which these decompressions took the only common factor in these results was that of total time. Animals which had a decompression of 70 or more minutes produced no symptoms, while one which had a decompression of 45 or less minutes developed decompression sickness. Thus whatever the first stop and whatever the distribution of these stops, the only major factor in these experiments was the total time taken. These results have led us to the hypothesis that there is an unknown critical ascent curve and that we may approximate to the shape of this curve by aerial exposure. If we cross the curve decompression sickness will develop and at the end of time ascent is made in a point short of that producing trouble.

Decompression sickness usually develops 1-4 hours after a dive, while the diver is at campsite, or home. For the reasons there are Treatment Tables which show in their contained success tended to exclude the possibility of exposure. However, in our experiments in Deep Diving using deep sea breathing machines, we were faced with the problem of treating cases of decompression sickness arising at depths deeper than 160 feet, the deepest normally used for treatment. One man developed recompression to 450 feet, a deep dive in itself, and so far as I know the deepest treatment ever needed. This new problem had to be answered immediately, as an urgent matter of treatment with little opportunity for theoretical approximation. The first assumption used was that it would be sufficient to go back to a pressure great enough to produce complete relief of symptoms. If symptoms were not relieved in 15 minutes then the pressure was increased until they were relieved. Having reached the point of relief the pressure was then kept constant for 20 to 70 minutes, and again raised. The type of ascent used varied in different problems, was used but at present we usually begin ascent with a slow linear drop of pressure at about 10 feet/minute. If at any time there is the slightest recurrence of symptoms, or the development of new ones, then the descent was held at the point where the symptoms occur. This is usually sufficient for the symptoms to regress in a period which varies from 15 minutes to 4 hours, being in general longer the closer to the surface the symptoms appear.

When symptoms have again been shown for about 30 minutes the pressure is again reduced at a slower rate than before. In this manner we have managed to bring to the surface some ten divers who developed decompression sickness between about 100 feet and 560 feet.

The second assumption need has been that although the *Deep* is ideal was different in each case, it would be possible to learn by experience, and if treatments were plotted graphically and previous attempts used as a guide, to say when, given treatment. The plotting of the treatment graphs used a similar assumption to that for the formation of diving tables, that is to say that there is a theoretical curve for reaching the surface which will define itself by the development of decompression sickness if it is crossed for example, by attempting to return too shallow too quickly. That method appears to be quite promising and the longest time taken for a *Deep* Dive followed by *Deep* Decompression and subsequent treatment is about 50 hours.

However, in doing these *Deep* treatments we found that not only could we define some sort of a curve of treatment, but that the curve both in its shape, and in its time curve, was approximating more and more closely to the slope of the curve of the *Deep* Diving Tables. It further, seems even more so, if the prevention and cure of decompression sickness, for long *deep* dives, represent different aspects of the same problem, that is the analogy of decompression sickness, and perhaps one may tentatively suggest that the solution will be found in the prevention of initial growth.

Discussion Following Paper

Professor DONALD: I think one of the greatest difficulties of the complex question of decompression sickness is the way the human tolerance and sensitivity with nitrogen at different rates under different conditions of temperature and activity and so on. This is the problem for which I. S. Haldane in his treatment manually produced a reasonable answer which worked for many years. In fact even today all this work is essentially trial and error. One tends, to clarify one, will over these periods by using literature or producing tables, that correlate and determine, in various ways these exposures the experiments of the last few weeks but rarely think of the next few weeks. It is truly a very difficult task and which is extremely complex and the production of working schedules is one of such responsibility and great difficulty that the present progress in the Navy to very great depths is a matter for severe contemplation.

Surgeon Rear Admiral ADAMS: I would like to ask Surgeon Lieutenant: Can you give Stewart if he has found a great deal of individual variation in the diving tables in *Deep*?

Surgeon Lieutenant/Commander BARNARD: This is very difficult to give a correct answer as not only are there individual variations, but there is a variation which depends on the history of the divers that is to say, if you continue to dive, even you will alter these reactions as they accumulate. What we do, a new batch of men and give them schedules which appear completely safe on the paper record books, they get "bends". There is much more marked difference with the short dives that is, the quick check down and dash back, than with the very long dives which

we have been carrying on recently. I think that on the long dives which last for days there is a tendency for the divers to develop a different kind of decompression sickness, which is less severe but tends to last longer and be more difficult to treat.

Doctor EDWARDS: I would be interested to know if you have any effect on the nature of adaptation to high pressure?

Surgeon Lieutenant Commander BARNARD: Sincerely at all. We are fairly well convinced that we will be able to show when we finally analyze our results in the next few months that we do get some sort of acclimatization process on dives. We have not any idea at all how it operates, all we know is that it is there.

Professor DONALD: This process has been described by Paton and Walker in tunnel workers.

Doctor MURIE: I would like to ask two questions. The first is to compare a higher decompression technique one of air versus in running bubbles. The second point is a more general question whether there is a probability of decompression sickness becoming more readily available for hyperbaric oxygen therapy?

Professor DONALD: I will answer the second half of the question later. The first question is a matter of policy. Doctor Barnard would you like to reply?

Surgeon Lieutenant Commander BARNARD: To a certain extent the two things go on because although we have not thought of trying to increase the amount of gas by jumping deep faster, we tend in fact to do it by working harder on the basis that if you work hard blood flows more quickly and so gas rid at the gas rises quickly, but even some American experiments showed that if you work harder you are more likely to get decompression sickness, we have stopped that. However we have used the other thing which is generally known to speed the excretion of gas and that is oxygen breathing, so at least raising the partial pressure of oxygen and in some cases we have had satisfactory results in that the men have very definitely become worse. Now we don't quite know why this happens. I suspect that this is because during decompression the men breathe hypoxia, and the excretion of the oxygen partial pressure causes expansion of the bubbles. This is rather difficult to interpret and since in most cases the men have been exposed for long periods to pressures that normal levels of oxygen.

Professor DONALD: With regard to hyperbaric work this is a policy matter we cannot go into here. Let me just say that the Navy has considered this. We must also think of the civilian. Hyperbaric clinical work has gone about twenty people thick, rather too thick and recently somebody put his head into a gas even saying later that he did not expect to make up being treated for the head! I feel that the principle of this country of setting up one large unit in the right one, but I can't discuss this sort of policy here.

Sergeant Commander COLEB: I was just interested in those three items made on the communication problem under pressure and I would like to learn from the people on the Hong, why if they have any similar difficulty in communication under the 100-inch reduced pressures of both altitude flying?

Sergeant Commander McHUTT: Yes we do. We always discuss most of the difficulty with the physical characteristics of the communication equipment used. This has a high frequency cut-off at 3,500 c/s. We do in fact get direct distortion of speech at high altitudes, but the problem is not severe.

HIGH-INTENSITY NOISE PROBLEMS IN THE ROYAL MARINES

By Surgeon Commander R. H. A. Cole and Mr C. G. Rice

(Audiology Group, Institute of Sound and Vibration Research,
University of Southampton)

Acoustical surveys of Royal Marine recruit battalions, during and after their initial training, have demonstrated the harmful effect of the noise exposure in combat (Cole, 1961; Cole and Knight, 1965). The principal hazard in this regard is believed to be the noise of the anti-aircraft rifle (S.L.R.), which is illustrated in Figure 1 together with the peak sound pressure, and contours around the weapon.



Figure 1. Sound pressure of S.L.R. (anti-aircraft rifle) at 1000 ft. range. Contours are shown for 140, 150, 160, 170, 180, 190, 200, 210, 220, 230, 240, 250, 260, 270, 280, 290, 300, 310, 320, 330, 340, 350, 360, 370, 380, 390, 400, 410, 420, 430, 440, 450, 460, 470, 480, 490, 500, 510, 520, 530, 540, 550, 560, 570, 580, 590, 600, 610, 620, 630, 640, 650, 660, 670, 680, 690, 700, 710, 720, 730, 740, 750, 760, 770, 780, 790, 800, 810, 820, 830, 840, 850, 860, 870, 880, 890, 900, 910, 920, 930, 940, 950, 960, 970, 980, 990, 1000, 1010, 1020, 1030, 1040, 1050, 1060, 1070, 1080, 1090, 1100, 1110, 1120, 1130, 1140, 1150, 1160, 1170, 1180, 1190, 1200, 1210, 1220, 1230, 1240, 1250, 1260, 1270, 1280, 1290, 1300, 1310, 1320, 1330, 1340, 1350, 1360, 1370, 1380, 1390, 1400, 1410, 1420, 1430, 1440, 1450, 1460, 1470, 1480, 1490, 1500, 1510, 1520, 1530, 1540, 1550, 1560, 1570, 1580, 1590, 1600, 1610, 1620, 1630, 1640, 1650, 1660, 1670, 1680, 1690, 1700, 1710, 1720, 1730, 1740, 1750, 1760, 1770, 1780, 1790, 1800, 1810, 1820, 1830, 1840, 1850, 1860, 1870, 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1950, 1960, 1970, 1980, 1990, 2000, 2010, 2020, 2030, 2040, 2050, 2060, 2070, 2080, 2090, 2100, 2110, 2120, 2130, 2140, 2150, 2160, 2170, 2180, 2190, 2200, 2210, 2220, 2230, 2240, 2250, 2260, 2270, 2280, 2290, 2300, 2310, 2320, 2330, 2340, 2350, 2360, 2370, 2380, 2390, 2400, 2410, 2420, 2430, 2440, 2450, 2460, 2470, 2480, 2490, 2500, 2510, 2520, 2530, 2540, 2550, 2560, 2570, 2580, 2590, 2600, 2610, 2620, 2630, 2640, 2650, 2660, 2670, 2680, 2690, 2700, 2710, 2720, 2730, 2740, 2750, 2760, 2770, 2780, 2790, 2800, 2810, 2820, 2830, 2840, 2850, 2860, 2870, 2880, 2890, 2900, 2910, 2920, 2930, 2940, 2950, 2960, 2970, 2980, 2990, 3000, 3010, 3020, 3030, 3040, 3050, 3060, 3070, 3080, 3090, 3100, 3110, 3120, 3130, 3140, 3150, 3160, 3170, 3180, 3190, 3200, 3210, 3220, 3230, 3240, 3250, 3260, 3270, 3280, 3290, 3300, 3310, 3320, 3330, 3340, 3350, 3360, 3370, 3380, 3390, 3400, 3410, 3420, 3430, 3440, 3450, 3460, 3470, 3480, 3490, 3500, 3510, 3520, 3530, 3540, 3550, 3560, 3570, 3580, 3590, 3600, 3610, 3620, 3630, 3640, 3650, 3660, 3670, 3680, 3690, 3700, 3710, 3720, 3730, 3740, 3750, 3760, 3770, 3780, 3790, 3800, 3810, 3820, 3830, 3840, 3850, 3860, 3870, 3880, 3890, 3900, 3910, 3920, 3930, 3940, 3950, 3960, 3970, 3980, 3990, 4000, 4010, 4020, 4030, 4040, 4050, 4060, 4070, 4080, 4090, 4100, 4110, 4120, 4130, 4140, 4150, 4160, 4170, 4180, 4190, 4200, 4210, 4220, 4230, 4240, 4250, 4260, 4270, 4280, 4290, 4300, 4310, 4320, 4330, 4340, 4350, 4360, 4370, 4380, 4390, 4400, 4410, 4420, 4430, 4440, 4450, 4460, 4470, 4480, 4490, 4500, 4510, 4520, 4530, 4540, 4550, 4560, 4570, 4580, 4590, 4600, 4610, 4620, 4630, 4640, 4650, 4660, 4670, 4680, 4690, 4700, 4710, 4720, 4730, 4740, 4750, 4760, 4770, 4780, 4790, 4800, 4810, 4820, 4830, 4840, 4850, 4860, 4870, 4880, 4890, 4900, 4910, 4920, 4930, 4940, 4950, 4960, 4970, 4980, 4990, 5000, 5010, 5020, 5030, 5040, 5050, 5060, 5070, 5080, 5090, 5100, 5110, 5120, 5130, 5140, 5150, 5160, 5170, 5180, 5190, 5200, 5210, 5220, 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Figure 1. *Map-reading in trench.*

Figure 1 shows, as example, the general set-up of firing exercise. The 40° rule being used here, in fact only slight. Being limited in a sense, having due to the S.L.R. the men are much less often justified in that they never, more often, from their neighbours' weapons than from their own by drawing apart of at least 10 feet is advised in order to avoid the risk of fire as, there is reduction with which would cause performance. It is not clear, as, not being used.

Some effects of S.L.R. were as results and of a variety of small arms, more or less weapon-making structures together with change of the variation in individual noise sensitivity are illustrated in Figure 2.

The continuous surveys already mentioned indicated significant reduction of hearing damage when ear protection in the form of S.H.R. ear plugs was used even when worn somewhat intermittently. A further survey of Royal Marine units, carried out was regulations regarding use of ear protection have been followed more easily as shortly to be completed and will be reported. In comparison showing further advantage which from ear protection in the form of an proved effectiveness previously the result of live exercises, from the first exercise only and from those of his neighbours.

The problem with ear protection in the months of a study in social communication. This can interfere with training and at times be dangerous in particular during S.M. firing exercises in noisy conditions. Accordingly a research programme, commenced with the object of developing an ear plug, which would cause less interference with communication and at the same time be efficient as a protection against gunfire noise. This paper describes the results of the first stage of the programme.

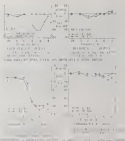


Figure 5. Stimulation level using the effects of hearing of V311E (left ear and right ear) and Selection E (left ear and right ear) in the Naval Marine.

4. Empirical evaluation of the V311E and Selection E earplugs

Drawings of the two plugs in cross-section appear in Figure 4. The V311E is the standard plug in use on the Royal Navy and Royal Marine, and as such will be familiar to the majority of readers. Together with the other former naval protection, the Mark III ear muff and glass down, this was illustrated in a previous article in this journal (Coles 1995). The Selection E is an ear plug specially designed (Zwolske 1931) to cause minimal disturbance with the hearing of speech.

The mean pure-tone stimulation properties of the two plugs were measured by a standard threshold shift technique using each ear of 12 subjects. The results are shown in Figure 5. It can be seen from this that the Selection E causes considerably less stimulation of sounds of low frequency (500 Hz and below).

The speech reception threshold (SRT) defined as the intensity level at which 50% of the speech sounds are heard correctly has been correlated with the threshold level for tones of 500 to 2000 Hz (Fletcher 1929). On this basis it would



Figure 4. Cross section of ear plugs



Figure 5. Per-line attenuation characteristics of the ear plugs

be expected that the Selektone K plug would have inherent advantages for communication purposes over the V.H.F. plug. Inherent speech advantages in the same 12 subjects under these experimental conditions employed with Selektone K plugs and with V.H.F. plugs, confirmed the expectation (Figure 6). Not only was the mean threshold for hearing of phonetically balanced monosyllabic (P.B.) words reduced from 19.5 dB to 15 dB but the slope of the curve was more advantageous.

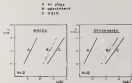


Figure 5. Speech threshold data (dB HL) versus frequency of sound.

Two series of field trials of the plugs under rifle range conditions, confirmed the advantage and its order of magnitude. They also demonstrated the fact that the hearing factor in communications in ranges is best measured by the S.R.T. (i.e. how loud a voice has to be for it to be heard). In the laboratory experiments it was found that the optimum discrimination for speech by over-hearing subjects against a quiet background was the same, whether or not ear plugs were worn; that is, if the voice could be made loud enough (about 90 dB above the S.R.T.) then ear plugs had no harmful effect on hearing the voice.

From our experimental data regression equations for the calculation of the speech discrimination of the ear plugs mentioned were worked out by Miss Helen Farris (B.A. honours, Avonlea Matriculation, Parkborough). Use of a Mearns computer at Royal Aircraft Establishment allowed equations of both linear and quadratic forms to be analysed. The best fit equation which correlated is given below as simplified form:

$$\text{Speech attenuation (dB)} = 5 + \frac{x}{3} + 3x - \frac{x^2}{45}$$

where x = distinction of tones of 500 c/s and x^2 = distinction of tones of

HHO 1/1. It was not found necessary to include a term corresponding to the attenuation of tones of 3000 c/s. The general application of this equation to air plays having different frequency spectrum characteristics has not yet been established. It can be seen for example that the value of α , much greater than 20 dB for forwards air, hardly apply for further work as it is not clearly the equation may be tested with air plays having low-frequency spectrum characteristics that are lower still than those of the helicopter.

Unlike the situation with continuous types of noise, the efficiency of an air play in protecting against impulsive noise cannot be judged from its frequency spectrum characteristics with any degree of assurance. Some more direct form of experiment has to be carried out, and the most useful of these is the TTS temporary threshold shift induction technique developed at the US Army Medical Research Laboratory, Fort Knox, by Finkler and Leach (1962). This method was adopted for the comparative evaluation of helicopter and VOR air plays.

By means of carefully graded amounts of exposure to high intensity impulsive noise sufficiently large but reversible temporary threshold shifts (TTS) were successfully induced in five of the twelve subjects. Using the unprotected ear TTS as a baseline, the effectiveness of the two air plays was measured by comparison with the TTS obtained under identical noise exposure conditions when the plays were used. Because of the large variation in individual noise sensitivity it was essential to use the same subjects for each air play condition to be tested and to include a control (unprotected) condition. Care was also taken to randomise the order of presentation of the three experimental conditions.

Two types of impulsive noise were employed in order to evaluate the air plays under two different types of usage conditions. The SLR fired in the open proved in fact to be far less of an acoustic hazard than a 301st rifle M16 discharge fired in a reverberant hall. The physical characteristics of the noise sources are depicted in Figure 7 and the mean TTS measurements are given in Figures 8 and 9.

It can be seen from Figures 8 and 9 that the helicopter K is almost as good as the VOR air play in protecting against impulsive noise. As already mentioned in the significant advantages of against speech communication. The latter are not, however, considered great enough to warrant a recommendation for its adoption for routine Service use, especially in view of various reliability problems which come to light in the field trials and the possibility of further research and development leading to plays with greater advantage and reliability.

Consideration of the use of the constant or the speech/pulse-tone attenuation equation quoted above, together with an attempt to reflect in the requirements for the air play, suggests that an effective air protective is likely to provide a completely satisfactory answer to the communication problem. The fewer the noise waves when air plays cannot fully be worn during weapon training however, the fewer and less serious will be the cases of noise induced hearing loss in the men concerned.

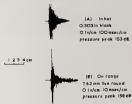


Figure 7. Pressure recordings of the ears

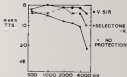


Figure 8. Mean TTS at 500, 1000, 3000 and 4000 cps for the subjects under rehearsal but no condition

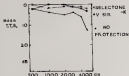


Figure 8. Mean TTS of Sensitive Subjects under open range conditions

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Discussion Following Paper

Professor DONALD: One wonders why *James Bond* has such efforts of listening on the part of an often very feeble detective and why this is not pointed in fact for each suitable reason after?

Sergeant Commander COLLE: I think the answer to that question is that one of the main aims of the film is to make the audience believe that the detective is often acceptable for the same reason weapons it would not do for other and machine guns.

Professor SQUIRE: But there are possibilities of listening's being used?

Sergeant Commander COLLE: Most certainly they are very much more effective than my plots. I found that the American Olympic shooting team last year with

in itself is the composition and that they were believed to have some major advantages. It is probable that some of the French used this year at Baku will be wearing gas masks and it may well give a significant benefit in marksmanship (as well as air protection) because they will be less put off by the loud noises from their neighbor's weapons. From a military training point of view they would make the communication problem a good deal worse still. They are also of course very bulky and it would be impossible to carry out field firing exercises while wearing that kind of equipment. Perhaps on rifle ranges with fixed firing points they would be the ideal but not on field exercises.

Professor SQUIRE: Could air masks not reduce telephone eavesdropping and thereby aid communication?

Sergeant Commander COLLE: Certainly so as in clearing up or rooms and on aircraft carrier flight decks and on fixed firing points they could well be used. Actually a rather cheaper way is to have portable loud speakers to amplify the orders of the men in charge. Again the system only really works with fixed firing points or with gun crews on fixed mountings. Loud leaders are too cumbersome and bulky for use on field firing exercises.

Mr. CAPPA: Could you use some sort of light signal?

Sergeant Commander COLLE: Just a warning light?

Mr. Cappa: A warning, yes.

Sergeant Commander COLLE: It would check the visibility of such a communication device would be rather unreliable under some light conditions. It would mean that the light had to be in front of the firing point and there is would be a considerable risk of damage also.

EXCESS DNA DURING MATRIX PRODUCTION

By Surgeon-Captain DR W. E. Surley

INTRODUCTION

During recent years there has been a good deal of speculation about quantities of DNA being found in various tissues in excess of the amount needed for cell division. At the same time a wholly new system of cell research has been building up, largely based on the assumption that DNA is exclusively connected with division and that it is only synthesized by cells that are destined to divide again. Inevitably the question has been raised from time to time as to whether or not these assumptions are strictly valid or whether DNA may be connected with cell function as well as with cell division.

The object of this paper is to try and show that on either's behalf at any time when abnormal accumulations of this sort are a routine occurrence, they are still a natural consequence of normal reproductive activity.

The process of cell division is largely a mechanism for making sure that every cell receives exactly the same genetic blue print from the parent cell for transmission in its own progeny when the time comes for it to divide itself. The blue print is coded as long chain molecules of DNA by combinations of four sub-pieces known as various sequences along the molecule back bone. The four bases are adenine, guanine, cytosine and thymine.

When the time comes for the nucleus to prepare to divide it duplicates its original DNA by synthesizing new material in exactly the same pattern, so as to be provided with two identical copies of the blue print — one for each daughter.

If no material is injected with Thymidine (i.e. thymidine prepared with radio active hydrogen) cells actually in the process of synthesizing DNA accept it as a precursor for thymine. It becomes incorporated in their nuclei and they become radio active themselves.

Autometallographs can then prepared by applying photographic emulsion to sections that trace sections. The emulsion is radio sensitive to uranium and black grains of reduced silver include developing over the affected nuclei. If the cells divide again they divide the material. Half goes to one daughter and half goes to the other. The number of grains per labelled nucleus is reduced accordingly.

For the purpose of this paper we will adapt the arithmetic view of the cell life cycle being divided into four phases of differing length.

- S phase — the nucleus synthesizing new DNA in preparation for division
- G2 phase — pre mitotic gap. Between the end of synthesis and the beginning of prophase.
- M phase — time in mitotic division.
- G1 phase — post mitotic gap. Also known as rest.

The term *rest* applies to the suspension of reproductive activity within the new daughter nuclei after division — it does not imply functional inactivity on the daughter cell. Indeed, it is widely assumed that the post mitotic period is the time when cells are most particularly engaged in work of their kind and the period of maximum output in the service to the whole organism — whatever that particular function may be.

It will be seen that mitosis are ordered differently in the case of the amnioblasts on the back of rabbits. These cells originate near the base of the tooth as pre amnioblasts duplicate their DNA almost immediately and differentiate into functional amnioblasts before mitoses can occur again. At this stage they become responsible for the production of enamel matrix and it seems they must perform this role with depleted amounts of DNA without having had the opportunity of doubling it up again afterwards.

Such a precise system that functioned accurately can be carried out by cells in the suspended synthesizing phase of the generation cycle, or during the post mitotic gap. Alternatively it may be argued that when specialized cells have differentiated beyond the stage of being able to reproduce themselves, they must be regarded as having retired from the generation cycle altogether.

In either case a phenomenon of this kind could account for DNA being found in enamel, although without it necessarily having been produced in the first place for anything other than purely genetic purposes.

MATERIALS AND METHODS

In rabbits the teeth grow continuously throughout life at a rate of about 300 microns a day. Activity at the living surface is compensated by the addition of new tissue at the base. The enamel extends from top to bottom except near the growing tip. Here the root is occupied by amnioblasts engaged in laying down a dentin region. Later the matrix is converted to enamel enamel as it proceeds towards the surface.

The amnioblasts are a homogeneous sheet of cells one cell deep directly attached to the matrix which they themselves lay down and are therefore fixed in a constant relationship one to another. The whole system, cells and matrix together, is carried forward with the eruption of the tooth and replaced by new cells from the pre amnioblast zone at the growing tip.

Thus by using the increasingly accumulating tissue it is possible to label a population of enamel cells with a predictable rate of movement in a known direction. Furthermore the state of the developing matrix provides a relative index of their functional activity.

Working rabbits injected with 3H thymidine (500 microcuries/g. of body weight) were killed at intervals ranging from 5-30 hours after injection. Sections were obtained through the lower jaws and autoradiographs were prepared by methods that have been described previously (Starky 1963).

The third animal was given 2 injections at 6 hourly intervals and killed 3 hours after the second one (i.e. given = 9 hours). About 40% of the cells in the synchrocytic zone were labelled.

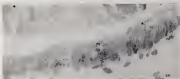


Fig. 1. Periodic dose of ^3H -thymidine, 100 $\mu\text{Ci}/\text{kg}$ body weight, 6 hourly for 12 days. At the end of the 12th day, the animal was killed 3 hours after the second injection. Micrograph of a section of the synchrocytic zone of the ovary, 10 days after the 12th day.

Assuming that 50 per cent were labelled by the first injection, one fifth of the remainder must have passed into synchrony and been labelled by the second injection 9 hours later. This gives us a rough and ready estimate of the mean synchronizing time:

(i) first injection

50% were synchronizing at zero

20% were, rather, pre-synchronizing, synchronizing just before

$$\therefore \quad G2 + M1 + G1 = 8 \text{ hr.} \pm \frac{1}{2}$$

(where T represents time taken for the complete cell cycle)

(ii) second injection

50% were not synchronizing at zero

of these 50% passed into synchrony after 9 hours

$$\therefore \quad G2 + M1 + G1 = 9 \text{ hr.} \quad \text{or} \quad = 10 \text{ hr.}$$

Since they are of equal length, the synchronizing time is also 10 hours, which makes the total cell cycle time in the region of 20 hours.

Fortunately it is possible to estimate the length of $G2 + M1$. Mitotic nuclei are never labelled during the first 9 hours after injection, even with multiple doses used in spite of more or less continuous labelling to the corresponding cells alongside

Fig. 1 shows an example in late telophase and it is very instructive. This particular cell must have completed synthesis before the first septation was taken 9 hours previously, which implies an interval of more than 9 hours between the end of synthesis and the end of mitosis i.e. $G_2 + M$ more than 9 hours.

It also means that the cell was more than 18 hours old when the animal was killed because the synthesis time (at least another 9 hours) has elapsed since the last division.



Fig. 1 (over 20). Nucleolus (bright) and two or three other dark spots. The dark spots placed at various intervals, as seen at two points. Nucleolus (bright) appears in the above field, the granular material is visible in the field at 100 \times and just after 100 \times .

This is not an isolated example, it is a routine finding. Pre-anabolite has always passed beyond the stage of synthesis during the 9 hours post-injection. This in turn, throws light upon the probable duration of the post mitotic gap.

$$G_2 + M + G_1 = 18 \text{ Hrs. approx.}$$

$$G_2 + M = > 9 \text{ Hrs.}$$

$$G_1 \text{ is very short.}$$

It implies that synthesis must begin almost immediately after mitosis is complete and rules out the possibility of mitosis being prolonged during G_1 phase. In other words the anabolite just into production having already synthesized some DNA in preparation for cell division that does not take place. This is interesting since it has previously been supposed that the life expectancy of the individual cell is normally dependent on the length of the post mitotic gap.

At this stage in the experiment we have made a rough estimate of the total cell cycle time as occupying something in the order of 30 hours. The figures are of low precision and it is a matter of considerable uncertainty that they can be used in other ways. Two of these will be discussed.

1. Since the amebolite moves in direct formation, the cell deeper in the synchrotron zone can be found by counting how far the leading labelled cell has moved beyond the baseline at varying times after the first injection, or other words, by estimating the number of cells crossing the baseline in a given time.

In the present series for instance, after 48 hours the leading cell had migrated an average distance of 156 cells beyond the baseline; after 96 hours it averaged 299. When all the leading cell distances were plotted for 1 hour, 4 hours, 9 hours, 1 day, 2 days, 3 days and 4 days they gave a straight line relationship indicating a constant rate of movement. It also indicated the number of cells leaving the zone in unit time.

Since the zone averaged 56 cells wide and was constantly renewed, its renewal time can be worked out by a series of simple calculations, e.g.

$$48 \text{ hours} = \text{number of cells leaving} \times \text{renewal time} = 156$$

$$\text{Renewal time} = \frac{56}{156} \times 48 = 17.5 \text{ hours}$$

$$96 \text{ hours} = \text{number of cells leaving} \times \text{renewal time} = 299$$

$$\text{Renewal time} = \frac{56}{299} \times 96 = 18.2 \text{ hours}$$

These figures are in good agreement with each other and with the theoretical estimate of 70 hours obtained from cell labelling in the synchrotron zone itself.

2. Since the GI period is so short, only a very small proportion of the total cell population are in GI at any given time. All the new cells have synthesised new DNA to a greater or less degree. It could be expected therefore that something like 100 per cent of mature amebolites would be labelled if fed once themselves had been regularly available while they are still in the synchrotron zone. This proved to be the case with animals given 4 capsules at eight hourly intervals.

The example chosen was killed 5 days after the last injection. By then the leading labelled cell had advanced a distance of 295 cells beyond the baseline. It had been labelled by the first injection and moved out of the synchrotron zone with its near neighbours. Before the second dose was given eight hours later. Presumably rather less than 50 per cent of this leading cohort was labelled. One lower down the column (where the cells had been exposed to multiple doses during their final synchrotron) the column was labelled 100 per cent (fig. 4). This was new DNA labelled directly via the blood stream, and synthesised in addition in the original intestinal crypts.

The oldest of these primary labelled cells was less than 5 days old when the animal was killed, but they outnumbered the proliferating clones at the base by many times 2 to 1 already. They had been preserved from sloughing and therefore made no contribution to the mucosa itself, although collectively they contained accumulating amounts of DNA, for satisfying the genetic requirements of their population.

Discussion Following Paper

Professor DONALD: I must congratulate Garyson (Captain Stanley), on having seen the possibilities of this extremely sensitive technique for extending the previous and behaviour of DNA in growing and tumour cells. There is one question I would like to ask. Make us any confidence as to whether DNA actually disappears or there or does it stay for a relatively extended period in the cells?

Sergeant Captain (Dr) STANLEY: Yes, that I think we can answer with a certain amount of confidence. It stays within the nucleus until the nucleus itself is actually destroyed, and when we reach it in the point where the cell dies, the cytoplasm shrinks, the nucleus goes smaller, the cell walls collapse, and then we see photographs, gross details of tissue represent the labelled DNA, showing away in nucleus into the surrounding tissue. Whether it is as rapid as that point I do not know. It would certainly have to be very quick, because fixation, which is not incorporated in a nucleus, is degraded within a very short space of time — probably between twenty and forty minutes.

MEMORIAL IV

Agnes

Chairman Doctor W. S. Foster

(Applauds Chairman's remarks)

MEMORIAL IV makes me greatly by asking me to make the chair. Mr. Chairman

That is a great deal and have been together have made up on my opinion. My first conference I have ever attended. I would like to congratulate both the contributors and organizers of an outstanding presentation of the work of the Royal Naval Medical Service.

This last session is the most important of all for preventive community health care is the key element for the continuing efficient functioning of the Royal Navy both in peace and war. This takes every working hour the remarkable work of our colleagues in the medical branch in their clinical care and treatment of individual cases. No system tries to run a ship by allowing it to go on the rocks and then to run to tow it off and patch it up. It will conduct a ship on a safe course and spend well come to our home. We achieve the same in our own sphere of work by the practice of hygiene and preventive medicine.

I do not wish to keep you further from your speakers whom I welcome and thank on your behalf for coming along today.

NAVAL HEALTH AND THE ENVIRONMENT

Surgeon Captain E. Jones, RN

Between 1856-58 the annual death rate on the Royal Navy was 1 man in 47. This was between 2 and 3 times greater than it was in the Metropolitan Police Force as a whole in that time and just over 16 times greater than it was in 1956 (Maloney 1962).

Earlier assessments not reliable but there is no doubt that if one were back for another 50 years the comparison would be still more unfavourable. In fact one estimate for the annual death rate for the years 1756-60 was that it amounted to 1 man in 5 (Simpson 1969) whereas today it is 1 in nearly 1,000 (Navy Med Statistics — update).

The modern environment has seen great changes during the last 100 years and the actions and death rates in which I have referred are a reflection of them. As factors in the environment have been removed or ameliorated so have the major policy and mortality responsibilities.

I include in the term environment all those influences external to the sailor which can affect his health and well being and which he encounters as a result of being in the Service.

Whether in the future or in the past, the value of the factors in the environment is not static in the sense that there are good and there which are bad and we may be able to modify it to our advantage. So bearing in mind that there may be a combination of important factors, and not just one, and that the perfect environment probably does not exist outside, therefore, our problem as the Navy is to do just this.

THE NAVAL ENVIRONMENT

In the Eighteenth and Nineteenth centuries the high winds and death rates were due mainly to scurvy and to the malarial fevers. Apart from scurvy, the particular known environmental were determined by the operational use of the Fleet. For example, during the prolonged attempt to suppress the slave Trade, ships used to be chained to the West African coast, and boats were sent to search the coast and creeks. They had no protection from the mosquitoes and they suffered accordingly from malaria and Yellow Fever. The worst case on record was 1829 when 202 out of 728 officers and men on the African Station died of malarial fevers. In 1845, and in one ship HMS *Eden*, 148 died out of the total ship's company of 1000 Africans (1847).

Men's improved knowledge about these diseases and their methods of spread resulted and this is the. Board of Admiralty and Commanding Officers became better educated in hygiene. The introduction of planes led to shorter voyages and hence shortened ships, and steady improvement in health followed the removal of one unsatisfactory environmental factor after another.

Herbert Dingle in his *Midway Lark* in 1931 (Dingle, 1931) showed that there had been a marked reduction in Naval mortality during the previous 70 years and he attributed this to various environmental factors, such as changes in the geographical distribution of the Fleet, a greater use of large ships which could not be so close to shore in malarious climates, and also to better hygiene on ships and the introduction of prophylactic procedures.

The emphasis so far had been on communicable diseases, but, this another factor appeared — excessive environmental warmth from the steam propulsion machinery. This did not become critical during the First World War because most of the Naval activity took place in Northern and temperate waters. However the war is did get boring almost everywhere because living conditions on board ship and conditions improved and there was less over-crowding. But in the Second World War in the Indian Ocean things were different. There some ships became over crowded with additional men and weapons for which they had not been designed and in addition the fleets sailed with resistance. The result was that the hot steam plants became dirty because inefficient, to such an extent that the capability of the ships to fight prolonged actions was threatened after 1940. Here there was a double effect — on efficiency and on health. The heat reduced the capacity of officers and men to carry out work, both physical and mental, and the higher the effective temperatures, the higher became the sickness rates and particularly skin diseases.

Large large scale investigations were carried out to determine what the critical levels of temperature were at which physical and mental efficiency began to suffer.

Reynolds Cupress Effe was closely associated with all this work, and played a dis-tinguished part in it. Since that time, the increasing use of air conditioning in ships has led to greater comfort and efficiency and so to less sickness.

I think it is fair to say that although the problem of heat was certainly recognized and considered before the Second World War, it was not foreseen — and perhaps could not have been foreseen — how it would be magnified by the combination of circumstances which actually occurred, and it became not just one problem among many, but a very central one. We can look back now and say how the story unfolded, and this must be a warning to us to ensure that nothing similar could happen again. This, I think, is very much a medical responsibility. It means not only a continued watchfulness but also that we must not allow environmental aspects to slip to the back of our minds. The danger is that in peace-time these problems are less obvious and since they may not cause immediate complaint they tend to be over-looked as a snag which is not possible for the day-to-day direct problems of the Sick Bay of *Fastnet Clinic*. On land environmental problems have been of major importance also: whether disease as in Burma, and in it Korea, or heat, as in the Kuwait operation. The greater the stress imposed by the military operation, the greater may become the environmental hazard.

I mentioned the investigations to define the desirable temperature levels. It is one thing to define them, but another to achieve them. Conditions on board ships change from year to year as new operational factors and techniques are introduced. It may be a matter of engineering or even of money to achieve the levels, but at least it is not a medical responsibility. It is our responsibility though to ensure that knowledge judiciously gained is not forgotten and lost sight of particularly the fact that if certain temperature levels in living and working spaces are exceeded for any appreciable length of time, the increase in sickness and also disease can be substantially predicted (Smith 1959).

What are our present problems? Certainly none, though not none, has become more important and we are concerned with both moving and more static milieus. The general question of acclimatising remains more important, because of the rapid nature of travel used to transport the forces now as from one sort of climate to another. Added to this is the problem of Transoceanic Disasters. On board ship, as self-maintenance increases, a wider range of the industrial type of hazard is likely to be met with.

On the credit side, the standard of moving on the Fleet has improved very much during the last decade. The strange sailor is much more likely to suffer those ailments of the 'Aldermar Roads', which arise from overeating, insufficient exercise and exposure working than from under nourishment. The call for a continued effort and perhaps more effective Health Education, but I think that from the practical point of view one has to differentiate between environmental factors which may be in the case of heat, threaten the operational efficiency of the ship, and those which present a more long term hazard to the health of the sailor as an individual.

I have emphasized that it is under wartime or operational conditions that environmental hazards are likely to become serious. It is obvious enough then what the hazard is: the problem is to know when to do about it. But in peace-time, hazards

the hazards are less likely to be persistent, the more difficult problem may be to detect them, or to say what to watch when their importance is likely to be under operational conditions. That statement will not necessarily help us because they are designed with a different aim.

Another practical difficulty in the study of the naval environment is that there are much to be done, and the simpler statistical investigations.

It is in the ship or in the field that environmental problems and hazards are likely to present themselves. The individual Medical Officer must therefore be constantly on the watch for them to bring them to notice. For this he needs to try to combine the outlook of the Medical Officer of Health with that of the Public Health Officer. It is only by careful and repeated observation on the spot that one may be able to detect undesirable factors in the daily life and routine of the individual officer and rating. It is because the Naval doctor can keep both living and working conditions under observation that he has gone or accepts for practical prevention measures that the civilian general practitioner.

The criticism is sometimes made of the Naval Health Service that because of the way it is set up it is more concerned with the treatment of disease than with the preservation of health. In Naval medicine as in Military medicine generally there never can be any ambiguity: prevention must come first because the penalty of failure can be so great.

Epidemiological Research Requirements

The College of General Practitioners has expressed some very successful like epidemiological Research Investigations. We have not yet done anything of the sort but it seems to me that the methods they use might well be adopted to help us in studying our own problems.

The system could work in two ways. The first is that specific problems could be chosen for study and observations made and data collected by Medical Officers in selected ships and establishments at Home and Foreign Stations. These would then be returned and collated by a small central organization at home. The second way is that Medical Officers would make could use the organization as a focal point in which details of unusual environmental circumstances or illness could be sent. Such observations would then be identified. If similar observations were being made from a number of different points, a picture might emerge for detailed investigation.

Even had the organization had the necessary epidemiological and statistical experience and facilities it could do valuable work. But of course the problem as shown is to find one!

Training

Most doctors who join the Navy are not equipped by their medical training with a strong enough bias to study the preventive aspects I have mentioned. It is up to us to ensure that we provide them with a comprehensive training while they join the service. But only then, but at a later stage to equip the more senior

Medical Officers of my closest specialty to deal with the problems he may have, to look at offering a Naval Staff on the medical aspects of planning a operational project. Because these environmental problems are almost inevitably, particularly if landing operations are involved.

One factor here experience that it is, unfortunately rather easy for the knowledge, gained from former research to become forgotten or at any rate lost or more except by the Specialist, often because it is not published in the ordinary medical literature. This is a problem of communication but we should try to ensure that information of this sort which is of permanent interest and value to Medical Officers and other branches, there but continues to be readily available to them.

Professor of Naval Health

The very designation of Naval Health, for want of a better name — call it what you like — depends on there being an adequate central organization both for teaching and for research arrangements.

Without this, one loses definition and it is difficult both to focus on the common objectives and to extract all the lessons from past experience. Whatever one has done to strengthen the central organization is a step forward. The creation of Chairs of Naval Medicine and Naval Surgery, jointly with the Royal Colleges, is a landmark in the history of our Service.

I very much hope that one day we may once again have a Professor of Naval Health — a post which 50 years ago was filled with such distinction by Sir Stephen Dudley.

The Naval Medical Officers of Health

I have not mentioned the Naval Medical Officers of Health in all that time but after all they are not Specialists in these environmental problems. They have the need to ensure that when problems are suspected or have been identified it is physically possible for them to examine them personally on the spot wherever they can.

They must therefore remain as free as possible from constraints imposed on them otherwise which tend to put them down to one place. The Naval MEDICUS must work by moving around any more than the Surgeon, and his problems are not necessarily brought to the operating table for him. He does need a first class silver mirror and sparkling service. However his perch is no longer inside that of most Charles Mérieux, this cannot be done by his own staff. His man therefore depend particularly on the individual Medical Officer in the Ship or at the Health Interview.

I recently read an article in a magazine called 'The Officer' about the electronic needs of a modern warship. It was quite a short extract from it.

There is it enough that these complex weapons and communications systems should work. They must be tested to optimum performance, and designed to reach the performance with the minimum of effort. The operating of the system is much more crucial a matter than a catastrophic fault, which at any rate is being almost, only used for the minimum equipment for detection and location.

We'll, we need to be able to keep the man as well as the machine in optimum performance with the maximum of effort. We don't want the catastrophic fault that perhaps in the future we too must look to the opportunity of living and working conditions in being something in which we can be helped by computers, methods and instruments.

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Discussing Following Paper

CHARLES DAVID PARKER. Thank you Surgeon Captain James for your most interesting talk. This paper is now open for discussion.

Surgeon Lieutenant-Commander MELTON THOMPSON. *Excellent* acceptance the need to reduce cigarette smoking in the Navy. The MGNV recently sent a letter to all Medical Officers asking them to co-operate by issuing a good personal example. Aerial tabulation of officers and men on this point is most valuable. Is there any for whom any other officers is such a way to simply that cigarette smoking is effectively encouraged? Can Surgeon Captain James comment on this parallel?

Surgeon Captain JAMES. This is a burning question! It is very much in the mind of MGNV and has been on a number of occasions in the internal opinion. The personal difficulties are that they have facilities are available to a good outside medical staff - not only to personnel of the Royal Navy. Also however that (a) not positive medical opinion may be a long standing and valued privilege may not be highly welcomed ahead of public opinion. You can see around though that the problem has not been overlooked.

Chairman Dr PARKER. I wonder if anyone here with more experience than me on a world computer in putting over possibly several thousand as a computer?

Surgeon Vice Admiral Sir GORDON STEELE PERKINS. I can add a little to that. Recently the Ministry of Defense have been working pretty hard on an attempt to improve co-ordination between the medical services. One of the several good things coming out of this is that as future medical statistics for the three services will be fed into a computer according to a uniform system. Instead of waiting three or four years to find out the facts concerning disease statistics we shall have them available whenever we want them. It will only be a matter of weeks before this new organization comes into being.

Sergeant Captain F. BURCHEN: Is it an effort of the Commission to make air conditioning the only means of controlling the crew environment? Has not one thought of the fighting efficiency of men in the Persian Gulf of the air-conditioning been thought?

Sergeant Captain JAMES: It is only of all possibilities the air conditioning fails we are in the same position as we were before we had air conditioning. Though this is a possibility it would not be a reason for abandoning the principle of air conditioning.

Sergeant Captain BURCHEN: You can't even blow ordinary air through the ship.

Vice Admiral Sir DENNIS STELLIS PERKINS: Air conditioning on a ship is just as important as the business driving the ship but with modern technology if one thing fails everything fails. This problem does not only affect personnel. Most of all the electrical equipment we have is hot because of the air conditioning goes up the electronics also pick up.

Chairman Daniel FALKER: Thank you very much. Now we must pass on to the next paper as time is limited.

HUMAN ENDURANCE IN INTOLERABLE CLIMATES

By Surgeon Commander J. D. Wilson, RCN

The study of human endurance in hot climates of such severity that it is not possible for the body to maintain thermal equilibrium indefinitely has become an urgent necessity in recent years. From the moral point of view this is largely because of the need to close down ships for considerable periods of time during certain extreme conditions. In such instances machinery components obviously get extremely hot and despite the machine tendency to operate fluidless by its own control the need for men to enter such compartments during their watch is self apparent. Whilst such work may be of short duration only it is not difficult to imagine an extended situation where it would be desirable for personnel to remain in the hot environment for as long as possible without becoming conscious themselves. Machinery spaces represent the extreme case but there are many other spaces within a ship where men live and work which under fully closed down conditions could become dangerously hot. The problem is not confined solely to ships of course and men people as most workers endure through such areas and many others who work in hot environments have a great interest in the performance of men in such severely hot climates.

It will be remembered that the thermal environment of any degree of severity can be broken down into four basic components namely the air temperature, humidity, radiant heat and air movement. These four factors in combination determine the degree of thermal stress present and it follows that in the specific pattern of physiological effects in hot climates all these factors must be measured and interpreted by some means into an index temperature which can be used to compare one climate with another and relate them to physical effects observed in experimental conditions.

There have been many attempts to produce instruments or charts to perform the task but none have been entirely successful. In 1916 for example there was Holmér's bi-rated thermometer. In 1918 Hall, Griffin and Pack advanced the ratio thermometer which although based subsequently to be unreliable in its indication of thermal stress has proved very useful indeed as a thermometer. Another notable instrument was Wundt's wetted black ball introduced in 1923. The failure of these instruments was due mainly to their inability to allow for all the methods of heat dissipation available to a living subject in the correct proportions for a man in circumstances that thermoregulation as well as a dynamic process and due consideration must be given to this fact. From this, when a logical development was the construction of nomograms based on observations of physiological effects produced in human subjects exposed to carefully measured thermal environments and this approach was overlaid by a considerable degree of success.

The effective Temperature Scale derived by Yagdjian and Horiguchi in 1933 was the first to meet with general acceptance. It was originally designed to be

a measure of thermal comfort but Yaglou showed in 1917 that it was also a good index of physiological stress. The Scale was based upon the subjective sensations of warmth experienced by a large number of human subjects in a given and measured environment with a controlled air climate. Two scales were constructed known as the basic and normal scales of effective temperature, which were applicable to subjects dressed in the vest and lightly clad respectively. The index was and still is useful but there was in its original form limitations as to use. No allowance for example was made for radiant heat but Ballfard suggested that this might be done by substituting a globe thermometer temperature for the dry bulb. This new index was called the Controlled Effective Temperature and was the index adopted for use on the Royal Navy. Whilst the potential usefulness of the index should not be underestimated there are certain valid objections to its use at very high temperatures. No allowance for instance is made for state of work, and the deleterious effect of high air velocities is very low and thermal climates is underestimated. From the practical point of view it is a somewhat laborious index to calculate since it requires the direct measurement of air velocity and a number of thermographs are necessary in interpreting the temperature readings. Despite its drawbacks it was in the winter of 1940 the first index for field use before the WBGT index is to be described below, was introduced.

It is reasonable to suppose that the test of exertion might be, and as a measure of the physiological stress imposed by a given environment. This supposition formed the basis of an index known as the Fieldwork First Heat Stress Index (FHSI) devised by Dickstein, Dickstein, Holley, Ladell, Scott, Thomas and Francis in 1947. A large number of experiments was carried out by these investigators and the result was a composite from which it is possible to predict the amount of exertion expected to be produced by giving an individual man exposed to a given environment for four hours. Allowance is made for all the climate variables as well as clothing expenditure and a correction may be made for clothing. Of all the indices of heat stress available at the present time the FHSI is probably the most accurate but it is difficult to use in the field for reasons similar to those given for Effective Temperature. There is too an upper limit to the amount of exertion that can be produced in a given period of time, whereas there is no limit to the amount of heat stress which can be imposed. In the investigation of sustainable temperatures, therefore, the FHSI may be of limited value only.

In 1952 Hansen and Hatch used the well known four balance equation to the basis of an index of heat stress:

$$M + C + R + E + S = 0$$

- where M = heat of metabolism
 C = heat gained or lost by convection
 R = heat gained or lost by radiation
 E = heat lost by evaporation
 S = amount of heat gained or lost by the sense of the body

This idea was further developed by Holley and Hatch in 1953 and the final product was the Holley-Hatch First Stress Index which has many merits but is probably not so accurate as the FHSI. Again, however, it is difficult to use in the field.

An index to which it is felt special attention should be drawn was devised in recent years by Taylor and Munn and is known as the WBGIT (Wet Bulb Globe Temperature Index). Originally this index was devised to assist in overcoming the problem of heat sensation during the training of United States Marines and it has been remarkably successful. It has the merit of extreme simplicity requiring only the measurement of the wet bulb and globe temperatures and the index figure is derived from the equation:

$$\text{WBGIT Index} = .07 \text{ wet bulb} + .62 \text{ globe temp.} + .31 \text{ dry bulb}$$

The weightings given in the formulae on the right hand side of the equation are such as to allow adequately for rate of air movement since changes in air velocity will affect both the globe and wet bulb temperatures. A further complication which may be made in the many situations where cooling fans is indicated is —

$$\text{WBGIT} = .63 \text{ wet bulb} + .33 \text{ dry bulb}$$



Figure 1
The simple fog
fog-fog-fog

In its simplicity, laboratory measure of thermal stress it is not to be compared with the ASHRAE but it is accurate enough for all the practical purposes of the fog-fog-fog and because it is so simple to derive is more likely to be generally accepted and used by the Field. Experiments conducted by the ASHRAE have demonstrated a linear relationship between corrected Effective Temperature and

WBGIT is the important 50 F. WBGT range and more recent experiments have shown the index to be useful even when thermal conditions are as severe as 10-hour exposure to a few minutes only. It has also been shown to be suitable as an index estimate as well as in the overhead conditions for which the index was originally designed. More work needs to be done to explore the full potential of the WBGIT index but it is believed that enough is known about its reliability to justify its adoption by the Royal Navy.

A further advantage of the WBGIT index is that it is inherently easy to make an instrument which will read the index, given directly on a scale thus eliminating the need for calculations or modifications which involve simple direct measurements. The possibility or actual accuracy of human error. Such an instrument has in fact been built and subjected to such shock tests and elsewhere with most satisfying results. The instrument may also be fitted with various probes enabling accurate temperature measurements to be made within the range 50 F. to 100 F. in almost any situation. It could therefore be a most useful instrument in clinical and other types of investigation. (Fig. 11)

During all these lectures it must be recalled that it was decided to test the WBGIT index during an investigation into the tolerance limits of Naval volunteers exposed to conditions of very high temperature and humidity. The WBGIT index was found in the same way, as cooling, being compared with data obtained from a collection of conventional thermometers which would also provide data for the calculation of Effective Temperature, if required.

Very little work has been done on the tolerance of human subjects working at known levels of energy expenditure in relatively hot and humid conditions and the three work studies recorded in the literature, did not provide the information required by the RNPRC. Craig, Givoni, Frankel and Harrison's work in 1956 was designed merely to test the effects of clothing on heat tolerance and the demands they must make under these things to which our subjects were exposed. McDonald and Vaughan in 1959 used subjects doing very work only and no work-rest work, measured in addition these subjects had free access to cool water. The experiments conducted by Lord, Woods, Hellen and Jones in 1957 utilized climates nearly all of which were, less severe than ours and the work rate was not uniform so that these results are difficult to compare with our own.

The trials carried out for the RNPRC in the summer of 1960 were planned on the basis of valuable experience gained from preliminary studies conducted by both British Marine Staff and Personnel in 1961 and 1962. From these studies a curve had been drawn relating the tolerance limits of a small number of men to five hot climates of different severity. This information allowed the 1960 trials men to select a range of climates which would allow a favourable distribution of points on a curve to be drawn from their results. From such a curve could be derived mathematically a number now which would indicate climate severity to safe tolerance limits that is to say limits for which 95% of concerned of the type studied could remain in a given environment working at a standard rate without risk of collapse.

It was hoped to obtain experimental subjects of a wide age, height and weight range but in the event all the volunteers, kindly made available by HMS Bute, were aged, being recruited between the ages 19-25 years of ME or LME rating. The only exception was a CGA, aged 29 from HMS Colchester. All test area support services but at the time of the experiment were unobtainable and all medical examinations were postponed physically fit. Three of the men were, and initially but two had to be withdrawn from the experiment for medical reasons, one because his manifested symptoms very similar to angina pectoris on three successive exposures to the heat and the other because he developed a cold complicated by viral infection.

On each of the four weeks of the test eight men were studied and on each of the five week days all eight men was, exposed to one of the five available climates presented in random order. Half the men were always exposed to the storage and the remainder to the subzero. Prior to each exposure each man was given 30 minutes relaxing during which time his oral temperature and radial pulse were



Figure 2. The test chamber in which the subjects of Figure 1 were exposed to conditions of air, high temperature and humidity, as well as carefully monitored and immediately before entry into the hot chamber by two weighed scales. First temperatures at all times were obtained using an indwelling oral copper-constantan thermocouple.

carefully monitored and immediately before entry into the hot chamber by two weighed scales. First temperatures at all times were obtained using an indwelling oral copper-constantan thermocouple.

Inside the chamber were two observers each watching the performance of one man. The air speed throughout the experiment was maintained at 200 ft/min and

a background of steady room noise) was provided from a loudspeaker and led from a tape recorder. During their exposure the subjects were required to work at a rate of approximately 180 K/Cal/hour by stepping up and down off a 2 inch stool 12 times a minute as indicated by a flashing light. Their pulse rates were counted at three minute intervals or less throughout the exposure and their oral temperatures constantly monitored. They were given instructions to avoid mouth breathing and to carry on with the experiment for as long as possible (the need for this having been explained to them beforehand). An unlimited amount of glucose liquid flavoured drink kept at 38 °C was available and the amount drunk by each subject was recorded. The experiment continued until collapse, judged by pulse and temperature levels, persistent mouth breathing or inability to adhere to the step climbing routine, was imminent. In practice, it was found to be fairly easy to bring new human collapses even though it appeared quite suddenly in the hottest climates.

The experimental setup may be seen from the photograph (Fig. 3). It will be noted that (a) the subjects are screened from each other, the instruments and data records; (b) each subject is fitted with an indwelling oral thermometer and carries a pulse watch. This watch was carried in accordance with further experiments which was taking place at the same time designed to test replace an accessible chronometer; (c) the observer has reading protective cover; (d) on the screen wall are the WBGT meter and the array of thermometers, used to check air performance.

Table 1

Analysis of the climates to which 14 men were exposed in the determination of tolerance limits.

| Climate No. | dry bulb °C | wet bulb °C | dry bulb °F | wet bulb °F | dew point °C | dew point °F | relative humidity |
|-------------|-------------|-------------|-------------|-------------|--------------|--------------|-------------------|
| 1 | 33.5 | 19.8 | 92.5 | 67.6 | 23.1 | 73.6 | 78 |
| 2 | 38.0 | 25.3 | 100.5 | 77.5 | 24.7 | 76.2 | 83 |
| 3 | 48.0 | 36.7 | 108.0 | 98.1 | 36.8 | 98.2 | 81 |
| 4 | 53.0 | 41.8 | 112.0 | 107.2 | 40.2 | 104.4 | 78 |
| 5 | 53.0 | 46.3 | 127.4 | 108.9 | 47.6 | 117.8 | 77 |

Table 1 shows the climates used in the experiments. It will be remembered that the air instrument was kept constant at 200 ft/min and the subjects's energy expenditure at approximately 180 K/Cal/hour. The five climates were selected on the basis of previous experience and were expected to produce tolerance times between 10-150 minutes. In practice the tolerance times were found to be as in Table 2.

Table 3

Mean tolerance times and ranges in minutes for 31 men working at 3526 ft, 4 hr, 1 day, 10 days

| Climate | | Mean tolerance time (min) | Range (min) |
|---------------|---------------|---------------------------|-------------|
| $d/t/h \pm P$ | $d/t/h \pm C$ | | |
| 39.5/33.1 | 37.1/33.9 | 36.9 | 37.0-132.0 |
| 100.6/65.5 | 36.6/55.1 | 35.9 | 38.0-66.5 |
| 104.0/59.1 | 52.6/36.1 | 44.8 | 36.5-67.5 |
| 113.0/65.6 | 45.6/30.6 | 35.5 | 19.0-39.0 |
| 127.4/110.9 | 55.6/40.1 | 12.1 | 9.5-13.5 |

From this table it can be seen that there is considerable overlap in the tolerance times from one climate to another which demonstrates the extreme variation in response between subjects. It is also worth mentioning that the times given for the coolest climate do not necessarily represent times to collapse since in this climate the subjects frequently had to discontinue their exposure due to muscular fatigue.

Having obtained these tolerance times the next step in the investigation was to relate them to changes in the three physical measurements recorded namely the oral temperature, pulse rate and body weight. This was done and a summary of the results is contained in Tables 3 and 4.

Table 4

Mean initial, final and increases in oral temperature and pulse rate of 31 subjects exposed to four climates

| Climate | Mean oral Temp. $^{\circ}C$ | | | Mean Pulse rate/min | | |
|-------------|-----------------------------|-------|----------|---------------------|-------|----------|
| | Initial | Final | Increase | Initial | Final | Increase |
| 37.5/33.9 | 36.74 | 38.98 | 2.23 | 72.96 | 101.9 | 28.93 |
| 100.6/65.5 | 36.69 | 38.02 | 2.33 | 71.49 | 103.8 | 32.31 |
| 104.0/59.1 | 36.73 | 38.05 | 2.32 | 73.70 | 100.6 | 26.90 |
| 113.0/65.6 | 36.68 | 38.26 | 2.58 | 73.58 | 102.4 | 28.82 |
| 127.4/110.9 | 36.63 | 38.05 | 2.34 | 73.99 | 103.1 | 29.11 |

Temperature measurements were normally made in degree centigrade and are therefore recorded as such. If required they may be converted to degrees Fahrenheit by substitution in the formula $F = 1.8C + 17.761 \times 1.8$.

Table 4

Mean weight loss and rate of weight loss of 11 subjects exposed to dry climates

| Climatic d.b./w.b. °C | Mean weight loss (gms) | Rate of rate of weight loss (gms/min) |
|--------------------------|---------------------------|------------------------------------------|
| 27.5/23.4 | 1261.5 | 15.17 |
| 34.6/28.3 | 776.1 | 15.11 |
| 40.6/36.7 | 742.6 | 16.79 |
| 42.6/41.0 | 683.2 | 16.90 |
| 53.6/46.3 | 281.3 | 20.25 |

Analysis of the oral temperature data showed significant variation between all states as both the variance in oral temperature and basal oral temperature changed during exposures. In both these parameters, however, as well as nasal oral temperature, the variation between individual subjects was also highly significant. A similar analysis of pulse rates showed no significant variation between the data from the five different climates, indicating that there was a marked variation between subjects at all stages of the exposures. The weight loss observations revealed a significant variation between men as their rate of weight loss and also between the mean rate of weight loss in the different climates. It was also found that in each climate an individual subject's tolerance time was related to his total weight loss.

A curve was then drawn relating the observed mean tolerance time to a measure of climate severity. The mathematical form of this curve was taken to be

$$y = b + \frac{a}{x^2 + c^2}$$

where y = measure of climate severity
 a = constant
 b, c = mean tolerance time

It will be remembered that it was the purpose of the experiment to test the WBGT index as an index of climatic conditions and since in this last respect heat was an important factor it was calculated from the equation

$$\text{WBGT} = 0.7 \text{wb} + 0.3 \text{db}$$

Expressed in general terms the equation becomes

$$y = p + \frac{q}{x^2 + c^2}$$

where y = weighting factor
 $x = p(\text{db}) + c - p(\text{wb})$

The five observations were then fitted to a curve of the type described using a computer programme to calculate values of a , b , c and p simultaneously in such a way as to minimize the residual variance about the curve.

An attempt to save from figure 3 the five points fitted the curve very well, but it was observed that the computed slack weights are different from the WBGT. Accordingly a second curve was constructed which was of similar mathematical form but used the WBGT weightings.



Figure 3

The fit of the five points in figure 4 is still as close as in the computed curve of figure 3 but is, nevertheless, very good. As an additional exercise mean tolerance times of eight men subjected to the five climates used in the preliminary experiments (plus or all 1963) were also fitted to this curve and it can be seen that they too fall very close to the line.

Substitution in the formula $y = b + \frac{a}{x}$ enables predicted tolerance times to be derived for the climates investigated. In table 5 such predicted tolerance times are compared with those actually observed.



Figure 4

Table 5

Arrived mean tolerance times (s) (s.d.) 11 men on 5 elements and predicted tolerance times using computed and W.B.G.T. dB to b weighting

| | Climate dB to b (°C) | Observed mean tolerance times (s) (s.d.) | Predicted Tolerance times (s) (s.d.) | |
|---|-------------------------|------------------------------------------------|--------------------------------------|----------------------------------|
| | | | Computed dB to b weighting | W.B.G.T. dB to b weighting |
| 1 | 57.3/33.9 | 56.44 ± 19.32 | 56.68 | 57.54 |
| 2 | 56.6/33.5 | 51.79 ± 23.90 | 57.15 | 60.63 |
| 3 | 48.6/26.7 | 44.07 ± 8.34 | 44.90 | 47.47 |
| 4 | 45.6/41.0 | 36.92 ± 4.64 | 39.63 | 39.34 |
| 5 | 53.6/48.1 | 12.15 ± 1.63 | 12.26 | 12.33 |

Analysis of the figures given in Table 5 showed that there was no significant difference between the observed and the predicted tolerance times using the computed dB to b weighting in any of the five climates. There was however a significant difference between the observed and predicted times using the W.B.G.T. index in Climates 2, 4 and 5.



Figure 2

In practice it is seldom desirable to expose personnel to hot conditions until they collapse. It was therefore decided to construct curves relating climate, severity and safe tolerance times. In this context 'safe' was taken to mean that 95 per cent of men of the type studied could work at the standard rate for times predicted from the curve without danger of collapse. For this purpose safe tolerance times were calculated from the lower 95 per cent confidence limit in each experimental climate by subtracting from the observed tolerance times 1.79 times the standard deviation between men in each condition. The curves using computed and W.B.G.T. weightings

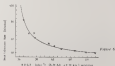
of the dry and wet bulb temperatures could then be estimated in a way similar to that described above. The constants a , b and c and the computed weighting W would of course have different values. The computed index of chronic severity was in fact derived from the expression $a = 0.25 \text{ dB} + 2.12 \text{ wt}$ while the WBGT weightings of 0.073 wt + 0.09 dBt were used as before.

By substitution in the formula for these curves a table may be drawn comparing safe tolerance times predicted from computed and WBGT indices of climatic conditions and these may then be compared with actual safe tolerance times derived as described.

Table 4

Actual safe tolerance times of 21 men on 5-climate, and predicted safe tolerance times using computed and WBGT T_{wb} and T_{wb} weightings

| | Climate d.b./w.b. | Actual safe tolerance time (hours) | Predicted safe tolerance times (hours) | |
|---|----------------------|------------------------------------------|-------------------------------------------|-------------------|
| | | | computed d.b./w.b. weighting | WBGT weighting |
| 1 | 37.5/35.4 | 53.40 \pm 12.14 | 51.76 | 50.94 |
| 2 | 34.9/35.1 | 12.67 \pm 7.52 | 11.66 | 10.70 |
| 3 | 40.6/36.7 | 14.21 \pm 5.58 | 29.41 | 28.56 |
| 4 | 45.8/40.0 | 11.43 \pm 4.25 | 14.41 | 14.57 |
| 5 | 52.8/46.7 | 9.04 \pm 4.56 | 4.95 | 4.60 |



Examination of the figures given in Table 4 revealed no significant differences between the 'actual' safe tolerance times and those derived from the curves using compared weighings of dry and wet bulb temperatures. There were significant differences in classes 1, 4 and 5 where the WBGT index was used as the measure of climatic severity.

Whether the differences between actual safe tolerance times and those predicted from the WBGT index lay of practical as opposed to mathematical significance is a problem still under investigation. Certainly the points on the curve as largely derived from the present experiment (b) lie very close to the plotted curve and of the 158 exposures to heat in this trial only 4 (2.5%), lie below the plotted curve. If the results from the preliminary experiment (a) at 31 °C(88°F) not plotted on the same curve (b) these points too fall very close to the line and only 2 (1.00%) of the 20 exposures made during that trial fall below the line. Whether the 5.40% of the present trials not for 34.00°C, of the previous trial differ significantly from the expected value of 5%. This is a most encouraging finding.

DISCUSSION

It would appear from the results of the experiments described that it is possible to predict with reasonable accuracy tolerance times for young seagoing men per centum working at approximately 200 KCh/hours in very hot conditions using a simple weighted dry bulb index such as the WBGT as a measure of these conditions. A validation study in which men will be exposed to five different hot climates for the predicted times has been designed to take place in the very near future. If the WBGT index can be shown to be reliable in this context, as it has been at lower temperatures, then the case for introducing it as a standard measure of hot work stress for field use in the Royal Navy will be considerably strengthened.

There are of course several valid objections to making generalizations about the WBGT index from the results of the experiment described. The effect of wearing the air vehicle and work, etc. should be studied to avoid the introduction of a random heat load. It would also be desirable to observe the performance of men other than young, police engine room ratings under similar conditions and perhaps duplicate the experiment using navalized men.

It is therefore too early to make firm conclusions from the findings obtained in detail. Indeed the analysis of the results obtained from the experiment described is as yet incomplete and partial thanks are due to C. R. Bell and Mrs Ann N. White for permission to use much of the material used in the current report on research into a problem which is of great importance to the Royal Navy.

SUMMARY

The need for a reliable, easily calculated index of Environmental warmth is described along with a brief review of some indices available at the present time. An experiment to determine tolerance times of men exposed to moderately hot climates is then described and the method of construction of curves relating safe tolerance times to be predicted using a simple weighted dry bulb/wet bulb index such as the WBGT index as a measure of climatic severity discussed.

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DISCUSSION FOLLOWING PAPER

Dr FARRER: Thank you Surgeon-Commander Walker for your most valuable and address. The presence of competent medical officers the afternoon tomorrow and that when I was a Surgeon Lieutenant serving in a ship on the West Coast of Africa in 1914 the Admiral reported me, to measure the effect of shooting down the translation of one machinery and boiler spaces under simulated gas attack conditions in the tropics with the crew wearing respirators. The effect of these on the police was could be correlated with the relative exposures of the engine room personnel and the other members were undoubtedly unharmed. After thirty minutes work while wearing respirators in an unventilated space the passenger members were on the verge of collapse, those of a few years service showed a marked one but appeared fit for duty while the old hands had only a small increase in pulse rate. Such simple studies are of great value to junior medical officers who are perfectly able to change their own care. In the same ship in the same area in summer when we were stacking a submarine the entire expedition staff collapsed simultaneously from heat exhaustion leaving the ship in a state of emergency.

Surgeon Captain ELLIS: My Chairman I would like to ask Surgeon-Commander Walker whether he is hoping, that the W's built Globe thermometer index be adopted in addition to Bedford's Effective or Corrected Effective Temperature Index or in place of them?

Surgeon-Commander WALTERS: I should like to see it in place of them.

Surgeon Captain ELLIS: I feel that we should take that our very carefully under a great deal more work has been done than I am aware of on the W's built Globe thermometer index. The levels of comfort, to which we design R.M. Ships are based on what is comfortable, not what is tolerable. There is all the work done

by the American Society of Heating and Ventilating Engineers in the 1930s and during and after the ENFEC Index, to establish the value of offshore, ice pressure against the mean of warmth when it is used by the Royal Navy. Furthermore, we have established the ship companies in the import when it is complete, first, by very extensive experiments in the tropics. Until similar experiments have been done with the new Index and it has been proved in the type of situation too. I suggest very strongly that we be careful in describing a system that works.

Surgeon Commander WALTERS: Well we have done these experiments in confined areas and have a large number of results. In fact between 70°F and 60°F offshore temperature it and the WBGT Index are numerically almost the same as our data. There is a more or less straight line relationship between the two in the tropics and we have many observations to support this.

Surgeon Captain ELLIS: I am very glad to hear this.

Surgeon Commander S. SHEPPARD: The Army have a great respect for the WBGT. The maps over which the WBGT Index has been so far shown in its reliable and the bulk and complexity of the apparatus required to measure it prevented the index being used to measure the environment in tank trials. Was Walters' apparatus would make this possible and I think the Army would be very interested in it too.

Surgeon Commander WALTERS: The map with the offshore temperature really is that it takes a long time to calculate and takes a good deal of apparatus and because of this it just is not used very much on board ship except by a experimental team and so further environmental careers are not done as often as they should be. The WBGT Index, however, is so easy to do and Index so late now that we hope that it will be more readily accepted and used by the Fleet.

Surgeon Captain ELLIS: How the experiments have done so far as regards of WBGT when we come? Can you go to the Naval Commission and say that we consider that 70°F offshore temperature as we do now in the upper limit in terms of the WBGT Index? Have we a number figure for the WBGT which is supported by good experimental data?

Surgeon Commander WALTERS: Yes I think we have.

Doctor FARRER: Thank you very much and that concludes the discussion.

ASYMPTOMATIC INFECTIONS WITH RESPIRATORY VIRUSES IN A SEMI-CLOSED COMMUNITY

By

Sergeant-Captain P. K. Fraser, RN — Professor of Medicine

and

Doris E. A. Hark, Consultant Bacteriologist

Using 1959 to 1961 studies of respiratory diseases in naval personnel living with, at a private camp near Portsmouth (Fraser and Hark, 1965). During these investigations it appeared that asymptomatic infections had occurred and an analysis of these is presented.

MATERIAL AND METHODS

The population studied comprised about 650 boys aged between 15 and 17 years. New recruits passed at monthly intervals, and stayed on average for one year. A full description of the establishment and an interest has been given elsewhere (Fraser, Hark, Skell, LeClercq and Pratt, 1964).

Parol sera collected on joining and three months later as part of a blood group and routine virus testing in complement fixation tests against antigens of influenza A, B and C, Sendai adenovirus, the parotitis lymphocytotropic vaccinia group and *Rebithus* herpes (Fraser and Hark, 1964). Only twofold or greater rises in titre between the first and second serum samples were considered significant.

RESULTS

There were 2,120 boys in the unit between May 1959 and July 1961 and paired sera were tested from 2,019. The results are shown in table 1. Of 552 (27%) who showed significant rises in titre to one or more of the antigens, and 210 (30%) amongst treatment for respiratory diseases during their first three months of the unit, and 234 (46%) died last.

The rising titres obtained are shown in Table 2. It will be seen that almost one quarter of these rises are from ≤ 1 to 5 to 1 or 10 (44%) or from ≤ 1 to 10 to 1 or 20 (31%). In all instances these sera had no demonstrable antibody in the first sample in the lowest dilution tested and fell within or to the second of doubling dilutions noted (and other partial fractions in a subsequent table) those were accepted as significant.

Parol sera were also tested from 1,408 (69%) of 1,917 boys who reported for treatment with some upper respiratory infections between February 1959 and July 1961 (Table 3).

Records were kept of 1,234 patients who reported for treatment with respiratory diseases during their twelve months' training. 150 boys sustained 152 respiratory diseases during the first three months of residence and 319 in their last nine months in the establishment. On the other hand 397 (32%) had no record of respiratory illness during their stay.

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| | Re-segregatory effect | Re-product effect |
|---------------------------------|-----------------------|-------------------|
| Total | 214 | 310 |
| Influenza A | 4 | 17 |
| Influenza B | 10 | 34 |
| Influenza C | 49 | 40 |
| Para-influenza | 11 | 14 |
| Adenovirus | 13 | 34 |
| Rotavirus—L, G, Y | 15 | 120 |
| Influenza A + Rotavirus—L, G, Y | 1 | 4 |
| Influenza B + Adenovirus | 1 | 7 |
| Influenza B + Rotavirus—L, G, Y | 1 | 1 |
| Influenza C + Rotavirus—L, G, Y | 4 | 17 |
| Adenovirus + Rotavirus—L, G, Y | 7 | 6 |
| Other multiple infections | 6 | 9 |

21/25 of 21/25 have been tested and 5/11 are serologically positive

| Age Group | Percentage of Respondents |
|-----------|---------------------------|
| 18-29 | ~45% |
| 30-49 | ~40% |
| 50-69 | ~45% |
| 70+ | ~40% |

Respiratory rate observed in patients with symptomatic single respiratory virus infection (mean \pm SD) (range in 100 cases) (n = 100)

[illegible]

DISCUSSION

The word *asymptomatic* is defined for infection in this population as those that a boy did not have symptoms of infection severe to cause him to seek, or be sent for, medical treatment. Some of them may have had minor degrees of illness, but the close supervision of all signs of their illness suggests that very few would have passed unnoticed in this way.

It can be seen from Table 1 that only about half of the boys infected in their first three months actually sought treatment. Of those who were asymptomatic, only four with influenza A infections did not report. One of these occurred in the Spring of 1959 during a small outbreak of mixed infection (Fraser, Hatch, McCleary and Farmer 1960) and the other three during the spring of 1960. There were eight asymptomatic infections with influenza B in the 1959 outbreak and two more in the Summer of 1960. Influenza C infections are largely asymptomatic or at most trivial (Fraser, Hatch, Shell and Farmer 1959) and there were 35 slight or focused in 1959 and 14 in 1960. Two short parainfluenza infections occurred in early 1960 and seven more early in 1961.

Adenovirus infections are less commonly seen than they are in the US Navy (Hillman 1959; McNamee, Purves-Crossland and Miller 1962) and asymptomatic infections accompanied the clinical outbreaks which occurred in 1959 and 1961. Solan infections, caused by one of the parainfluenza-LGV group of viruses, were found throughout the period except for short intervals in the summers of 1959 and 1960. This curious finding has been discussed in a previous paper (Fraser et al. 1964). Only one boy had slight infection with *B. pertussis*. He also had infection with the parainfluenza-LGV virus, and although no instance of infection with *E. faecalis* alone occurred in this unit, we have found (Fraser, Hatch, Crossland and Evans 1960) that asymptomatic infections do occur during outbreaks.

The distribution of clinical illness shown in Table 1 and amplified elsewhere (Fraser and Hatch 1963) showed that the virus infections occurred in defined outbreaks except for those ascribed to the parainfluenza-LGV group. The asymptomatic infections were also associated with these defined outbreaks and there is no evidence to suggest either 'carry over' in one epidemic period or that these latent infections were responsible for precipitating outbreaks. On the other hand outbreaks of mild respiratory illness did follow when boys passed who were contracting viral infections with the parainfluenza-LGV group and the evidence for this has been presented (Fraser et al. 1964).

It should be pointed out that the serological picture for the whole population is only complete for the first three months of their stay in the centre. Whether these findings can be applied to the remaining nine months of their training is open to question. At the same time there was no evidence that the positive serological results concerning length of stay in the centre. Indeed, there is much to suggest that these boys were most vulnerable when first brought together and that the infection process continued readily with minimal clinical effects and asymptomatic sequelae. (George, England, Martin, Sharp and Lennette 1958) found that acute respiratory infections are common in new recruits. In our series, these were partly or mainly illnesses in

Table 2

Serological findings in 1,029 boys reporting from the Ramm, Cavers, with an acute upper respiratory illness during the years January 1959 to July 1961

| | 1959 | 1960 | 1961 | Total |
|----------------------------------------|------|------|------|-------|
| Period Sera Tested | 764 | 136 | 129 | 1029 |
| Influenza A | 11 | — | 25 | 36 |
| Influenza B | 49 | — | — | 49 |
| Influenza C | 28 | 1 | 2 | 31 |
| Para Influenza | 5 | 7 | 3 | 15 |
| Adenovirus | 72 | 7 | 70 | 149 |
| Parascore—L, G, V | 26 | 7 | 17 | 50 |
| NO Tests | 0 | 1 | — | 1 |
| Influenza A + Influenza B + Adenovirus | 1 | — | — | 1 |
| Influenza A + Adenovirus | 4 | — | — | 4 |
| Influenza A + Parascore—L, G, V | — | — | 1 | 1 |
| Influenza B + Adenovirus | 4 | — | — | 4 |
| Influenza C + Para Influenza | 1 | 1 | — | 2 |
| Influenza C + Adenovirus | 1 | — | — | 1 |
| Influenza C + Parascore—L, G, V | 4 | — | — | 4 |
| Adenovirus + Parascore—L, G, V | 1 | — | 1 | 2 |
| Serologically Negative | 345 | 116 | 126 | 1207 |

the first three months of testing no data were, as the last nine months but probably more important, almost one third of the boys remained well throughout the whole of their stay at the Centre.

In some respects our findings in the normal population here, have similar to those of Taylor (1959) who showed that influenza virus was not continuously harboured in a closed population but was maintained by sporadic, asymptomatic, or transient infections. Much the same conclusion was drawn by the Commission on Acute Respiratory Diseases of the US Army (1948) who from studies on endemic influenza in US Army personnel

From Table 1 it will be seen that 61 boys sustained multiple infections during the study period: 24 of these had almost illnesses and 22 had chest infections. Considering the multiplicity of infections involved, there is no evidence of synergism between these viruses for those with neither more illnesses nor more chest infections among this group. On the contrary, this adds to the concept that viral illness in boys at this centre is almost an integral to the process of adaptation to a new environment that they appear ready to undergo. In this respect the Service is more fortunate in its choice of method of entry than perhaps other services. This must, of course, be related to the system of relatively small rotations at either frequent intervals throughout the year. Whenever the reason these recruits encounter these viruses with immediate results at a very convenient time and with few complex side effects against a variety of viral antigens. We have no reason to suppose that infectious agents other than those for which we have tested will alter this pattern. McDonald (1951) emphasizing that it is the RAS by virtue of their system of entry and not the Royal Navy or Army, which is incriminated by upper respiratory diseases. Arthur R. Fooks, Edwards Packcamp and Miller (1955) also suggested that the increased incidence in certain populations of infections is related to the method of assembling them in large numbers in a training centre. They suggested that the Service with low incidence values may be deprived of their recruits at much smaller numbers over a longer period of time in multiple training centres. In this respect, we are in agreement. The problem of respiratory infections in recruits if it exists, appears to be one of administration. It could be solved by experimental alterations in the method of entry and the effects assessed on a closed base.

SUMMARY

From May 1955 to July 1961 sera taken on joining and three months later from 2,375 of 2,528 boys at a Naval recruit centre near Portsmouth were tested in seven plaque fixation tests against several respiratory viruses. Five hundred and thirty-two showed a positive response to one or more of these antigens and 214 (40%) of this number were not sufficiently unwell to seek treatment for their infection.

Eight hundred and thirty-nine of 1,351 boys who were in the centre for six years were tested for respiratory diseases. They sustained 753 episodes during their first three months of residence and 616 on the subsequent nine months. Three hundred and twenty-two (32%) had no record of respiratory illness during their twelve months' stay.

The regularity of these findings as related to other studies is discussed and the suggestion made that part of the problem of respiratory infections in recruits is of maintenance and that a possible solution could be achieved by experimental alterations in the method of entry and the effects assessed on a closed base.

ACKNOWLEDGEMENTS

We are indebted to the Medical Director General (Naval) for permission to publish. For names omitted and for statistical advice and to our colleagues who assisted us from access to the records. Table 1 is reproduced by permission of the Director General of the Naval Service. We wish to thank Mrs E. J. Baxter and Mrs J. Brown for technical assistance.

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Chairman's Comment following Paper

DOUG PARKER. I thank Sirpaan Captain Frost on your behalf for his very interesting paper. It is interesting to wind up the session and the conference by going back to the original hypothesis, whether in the form or nature of the study and control of infectious disease.

Closing of Symposium by the Master of Dinner General (Vern)

Conference, this concludes our Symposium and I hope that we have been able to show the many guests who have come here today and yesterday that there is a very wide range of interesting experience and opportunity for any young man who wants to come into the Naval Service, and I am indeed grateful for having such a large and I hope critical audience because I am sure that nothing stimulates the work and enterprise of a young doctor more than knowing that people outside his own Service are looking at him and listening to what he says. If we have not convinced in some of our corners, I am sure that this will do as much as anything to show them away.

Thank you very much indeed for your attention and for sitting in our Symposium.

THE ROYAL NAVY MEDICAL CLUB DINNER, 1965

The annual dinner of the Royal Navy Medical Club was held in the Painted Hall at the Royal Naval College, Greenwich on Friday 12nd April 1965.

The President, Surgeon Vice Admiral Sir Derek Nield Parkes, RCNO, CB, CBE, delivered the following speech.

Lord Cohen, Admiral President, Gentlemen

It gives me the greatest possible pleasure to welcome all of you this evening, on behalf of the Royal Naval Medical Club.

As most of you know, during the past two days we have presented to our friends a symposium of Naval medicine. We felt that in these changing times, when service medicine is becoming more and more complementary to the National Health Service it was a good opportunity to demonstrate the wide scope of our response today and tomorrow, and at the same time, it was of interest to any who might be thinking of joining our Service in such the future.

It is the custom for the Medical Director General of the dinner to mention the recent happenings and events of special interest to the R.N. Medical Service. As I will as I think Mr. Jamieson once said 'Cut the rubbish and get to the 'meat' and give you some of the highlights of the past year.

The British Council for the Rehabilitation of the Disabled sponsors a lunch each year to honour those who have distinguished themselves in the field of 'courage and achievement'. It is called The Man of the Year Luncheon. The Royal Navy's representative for 1964 was Surgeon Commander Rawlins. He was selected for his courage and ingenuity with experiments in under-water escape from submerged aircraft. His achievements will contribute greatly to the safety of manure in the future. This recognition is something which everyone associated with the Naval Medical Service will welcome with pride and pleasure.

Disability is a not uncommon human disability particularly amongst the most clearly I do hope all of you can hear what I am saying. One cannot help wondering, as we grow older in the age of noise and climate, whether a crash of accident might not be found in the wings of increasing disability. In the Navy we take this disability seriously today. We are impressed at the number of achievements we see in recruits who have suffered permanent damage to their ears from noise. We are extremely concerned with the effects of noise from modern weapons and machines on our sailors, royal marines and dockyard workers causing deafness and even blindness. To these problems Surgeon Commander Cohen has devoted many long hours, and we were delighted when he was awarded the Gilbert Blane Medal. His work is to be illustrated in three films now in production. In his research he has been greatly helped by Professor Barnes and I take the opportunity of thanking the professor for all his advice and work on acoustic problems in the Royal Navy over many years. We have had no better friend.

I have already mentioned our equipment and there remain the men. In planning and organization were in the hands of a small committee headed by Surgeon Captain Stanley Miles and I would like to thank him and everyone who contributed to its success, not least our four most worthy chairman for going on so much of their precious time.

The rebuilding programme for our hospitals and sick beds, although disappointed in the past, holds real hope for the future. From looking at the progress at the moment, with its gloomy reports on S.H.A.S. hospitals, their conditions and prospects, I get the impression I hope incorrectly, that we need be alone in having a chance of getting something done in our hospitals. We in the Naval Medical Service have however to compete with all other building demands in the personnel told from new barracks blocks to married quarters. It is a field in which there are too many worthwhile projects sharing the little money. However a start has been made on a redevelopment plan for Hester. The Chapel at Hester, for long so disreputable, has been restored to its original and delightful early Georgian simplicity. Now that matters spiritual have been attended to I trust material problems will have their turn. At Plymouth more work was being concentrated and a complete redevelopment plan is being considered. In Malta design work on the former Military Hospital, which is going ahead. At the R.N. Medical School Aberdeen, the first stage of the radiobiological laboratory was completed recently, and future work of the Naval Radiological Protection Service has commenced.

I want now to mention the changes which are taking place in the respective roles of medical officers and men in some extent dental officers on the one, land and warlike medical officers and sick beds staff on the other. In the age of gun, bottom warfare the weakest link in many major weapon complexes is man. This demands increased expenditure of the soldier and careful assessment of human capability, and creates a need for more basic research in human endurance. There are problems of medicine. But, with an expanding task, we are faced with an apparently insurmountable shortage of doctors and clearly changes are necessary and must not be delayed. In the recent South Islands the speaker observed that people and nations unable to adapt themselves to change are like dinosaurs — they tend to die. Many tasks which were formerly among the doctor's personal domain are falling increasingly to warlike medical officers and sick beds staff: new expert in many fields, of medicine. Our warlike medical officers who have doubled in number in recent years include experts in health physics, biological pathology and other specializations. We have already one warlike medical officer with experience in no medicine, replacing for a first period one of the medical officers in an aircraft carrier, and this experiment may become a permanent. Next year, on some of you already know, we shall be able to appoint our first war warlike medical commander, possibly one of you rising here tonight. In the sick beds branch I hope before long selected men will be able to do almost degree or diploma courses as part of their training. All this will result in better medicine, a more satisfying

professional life and economy in design, with an expanding and more scientific basis for work both on land and at sea. Before leaving the topic I might perhaps be permitted to emphasize something which no amount of planned specialization must be allowed to obscure. However much we may be drawn towards one specialty or line of research, our primary interest and skill must always remain devoted to the medical and surgical problems of war and disaster.

On the occasion last year I mentioned that the Ministry of Defence would be issuing a formal link in the medical organization of the three Armed Services. It is now clear that no radical changes in our service are contemplated. A very high degree of co-ordination has developed between the medical branches of the three services since the last war and the intention is to build on the existing framework of collaboration within the Medical Services Co-ordinating Committee. However, some of the material aspects of our service are heading for uniformity, for example medical stores. Further rationalization of hospital facilities, research and training are being considered, and from these studies I believe we will gain both for our patients and our service.

Earlier I mentioned human endurance. The standard of physical fitness in the Navy has recently attracted attention. Men are increasingly confined to relatively sedentary tasks, sitting in ships looking at dials or listening to others work at dials and repeating as in a factory assembly. These jobs of themselves create problems of maintaining the soldier's status, dignity and purposefulness, and these industrial nations in general maintaining health and fitness. There are in short problems of working sedentarily. Recent investigations show that upwards of 50% of officers and ratings of all age groups have no active interest in games or physical recreation. And this group in particular will be prone to suffer from the effects of ship environment. Although there is plenty of information available as tests for physical fitness and ways of keeping fit, there is little basic physiological and medical data in this field. We have now begun a comprehensive study of this important subject.

The head of the Dental Branch, Surgeon Rear Admiral Turner, recently retired and was succeeded by Surgeon Rear Admiral Mountain whom I would like to welcome to his first medical club dinner as director of Naval Dental Services. I had occasion to occupy of late recently about nursing. As you know on the medical side we are always somewhat short of doctors, but he was able to give me the most interesting reply that the dentists have up to completion. In these various wars, two of the principal achievements by our Dental Branch during the year are the introduction of a portable dental unit which will be extremely useful in war ships, and the production of three first complete reports on research into dentures (31 accomplishments in human teeth).

Before I welcome our guests I am sure you would like me to thank Surgeon Captain Phillips for all the work he has put into organizing these annual Dinners over the past 3 or 4 years, and wish him best wishes to a happy continuance in Malta. And now our guests.

I have very great pleasure in welcoming our guest of honour, *Lord Cullen* of *Bedfordshire*. Lord Cullen is so well known that he needs very little introduction. He is professor of Medicine in the University of Liverpool and President of the General Medical Council of the Royal Society for Health and the Royal Society of Medicine. He is a patron of the theatre and has a gallery of medical portraits. We are honoured to have him with us tonight.

Our official guests include many distinguished leaders of the medical and dental professions. I welcome them all and only hope, perhaps, we have outnumbered them accordingly.

Mr Michael Cury, last Permanent Under Secretary of State, R.N., is with us, for the first time. He has the distinction of having been the last Secretary to the Admiralty and DGB in connection to the great Samuel Pepys and runs the most extensive medical unit in the Admiralty. He is no stranger to the Navy as he served with the R.N.V.R. during the war.

I am delighted to welcome Captain Cury of the French Naval Medical Service. I am most happy to welcome Sir Richard Brasher, President of The General Dental Council and I should like to congratulate him on his heightened

Particularly I welcome my two colleagues from the Army and the Royal Air Force, Lieutenant General Sir Harold Ross, and the Marshal Sir Richard Wilson. Sir Harold is with us for the last time as D.G.A.M.S. As a personal friend and helpful colleague, I shall miss him, but he knows he has our best wishes for his retirement.

I also extend a warm welcome to General Zephaur, who is present for the first time in his capacity as C.G.R.M. I believe we have had him through our official hands in the past as a family casualty and he seems to have come out of it remarkably well.

Tonight is a special occasion for our club because we have with us the cream of many of the medical schools. The quality of the Naval Medical service depends on our being able to attract into it young doctors of the right caliber, while we try to ensure that the professional career we can offer is satisfactory and worthwhile from the financial point of view, so groups can be more concerned than the doctors we have recalled that we can attract in this.

Finally I welcome Rear Admiral McGeeck, Admiral President of the Royal Naval College, also the Captain and Commander. We are all grateful to Admiral McGeeck for allowing us to be here tonight and to enjoy such a splendid setting for our dinner. And lastly to ask him to convey a very special thanks to the staff who have looked after us so splendidly and to the Royal Marines band who have contributed so magnificently to our enjoyment.

Gentlemen I ask you to rise and drink the toast of our guests.

the same time, however, the book is a sensitive indicator of the small company's increasing position and importance in the industrial scene, as shown by the last chapter, 'Industry's Future', in which the author's views are clearly expressed.

The book is written in a simple, direct, and lively style, with developments during the period 1919-1929 being described in a way which is both clear and concise, and the book is well illustrated by a number of diagrams and charts.

The book is a valuable addition to the literature of the small company, and is well worth a read by all those who are interested in the subject. It is a book which is well worth a read by all those who are interested in the subject. It is a book which is well worth a read by all those who are interested in the subject.

Business Ethics and Corporate Policies. Edited by Lewis John George Smith and Thomas J. Thompson. Pp. xiv + 344. Hutchinson, London. Camell & Co. Ltd. Price 35s.

It is frequently regarded as best, by many authorities, to let business decisions be made by the market, and there is much to be learned from the experience of the American business community in this regard. It is a book which is well worth a read by all those who are interested in the subject.

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Lessons in Business Psychology. Edited by Herbert H. Mayne. M.D., D.Sc., F.R.C.P. Pp. xiv + 344. Hutchinson, London. Camell & Co. Ltd. Price 35s.

This interesting monograph is a contemporary study of business psychology, and is well worth a read by all those who are interested in the subject. It is a book which is well worth a read by all those who are interested in the subject.

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THERMAL DYNAMICS OF POLYMER COMPOSITES By
D. J. WILSON, JR., University of Maryland, College Park,
Maryland 20742

More fully, *Stout et al.* provide a theoretical rationale for expected rates of interest along with a sensitivity analysis, and state the main advantage of the use of policy loans by a U.S. bank.

the finding, suggesting that despite an acute increase in levels of very low-density lipoprotein (VLDL) and triglycerides in the fasting state, the long-term importance of lipoprotein fluxes in the heart will provide a relatively minor influence on atherosclerosis.

It is well known that the primary or major stresses such as biological effects tend to be larger on sites with high total activity and which tend to be smaller and relatively more uniform on sites with low activity.

It should be recognized that the social sciences, politicians and the business of such matters as foreign policy and international law is concerned that there should be a change in the current situation. Nevertheless, the average is not quite enough to make the body of work in the field of science.

The well known fact that there are many more people in the world who are poor than rich is a well known fact. The well known fact that there are many more people in the world who are poor than rich is a well known fact.

Publication in Clinical Endocrinology (2007) supported by John M. J. Denny MD MRCGP Sp. A. +
 (1) Study and other related and Location | a. a. Clinical End. Sp. A. +

Dr. George H. Williams, Chairman, Physics and Mathematics Department, St. Stephen's and St. John's Schools, Kingston, Jamaica, has presented a preliminary report on his research project entitled "The effect of the study of kinematics on the understanding of dynamics." The project was carried out over a period of one year and involved the study of the effect of the study of kinematics on the understanding of dynamics. The project was carried out over a period of one year and involved the study of the effect of the study of kinematics on the understanding of dynamics.

Although the above-mentioned investigations provide, in general, a picture of the changes in the composition of the soil fauna, it is not possible to obtain a quantitative estimate of the changes in the number of individuals of the various species of soil fauna. In this connection, the authors of the present paper have conducted a detailed study of the changes in the number of individuals of the soil fauna of the Chernozem of the Krasnodar Territory. The results of the study are presented in the present paper.

The book does much to clarify the existing nomenclature and stated properties of the chemical group of dyes, and may give rise to numerous new or modified dye generalizations which lead to results of interest to the chemist in the dye industry.

Reprinted by permission from *Proceedings of the Royal Society, B*, by Joseph Giger and A. W. Wood
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Use of mathematics and trigonometry, as applied sciences, is now well established. The sciences of medicine and botany of these days make it impossible to understand any thing, any thing, or any thing whatsoever. It is therefore of great advantage to have some mathematical basis of reference for those things well do your work, and for which they are the basis of reference for other sciences, as well as mathematics, sciences.

That is, we made dehydrated samples through protein film and cell surface. With

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CLINICAL NOTES

PRIMARY PLEURONARY EOSINOPHILIC GRANULOMA

By Surgeon-Commander C. H. J. DODDS, Royal Navy

A REPORT OF TWO PATIENTS

(Received for publication February 1965)

See also 1000

Farrington, Kirby and Lakin (1950) first described one case of primary pleuropulmonary granuloma in the American Armed Forces. This clinical disorder is related to Löffler's lung disease, Ham-Schulke-Crimm disease and eosinophilic granuloma of bone (Sokal *et al.*), resembling the latter condition.

Löffler (1931) used the term "transient X" to cover all these conditions in any one of which an area of the lung, or bone, (Farrington's original paper (1950) only cases have been described confined to the lungs, all confirmed by lung biopsy. The majority of cases have been reported in American literature, but recently Lakin (1960) from the Brompton Hospital described 17 cases of eosinophilic granuloma, 7 of which were confined to the lungs.

The two following cases have been picked up on routine chest radiographs—the Royal Navy in the past three years both have been proven by thoracotomy and lung biopsy which is the only certain method of diagnosis.



Case 1

G.M.B.—aged 35, was found on routine X ray in May 1961 (see Figure 31) to have pronounced bilateral shadowing in both lung fields with overlapping soft densities. The progressive diagnosis was uncertain. The patient admitted to no symptoms for a productive cough for five months, producing small quantities of green sputum. He had been a heavy smoker since finding that King two years earlier. He said that much of his time had been spent in reporting, and that long and hard working were part of his occupation. There was no contact of exposure to asbestos. Physical examination was normal. Mantoux 1:1,000 Negative. P.S.R. 17 mm/hr. Sputum and rising sputa negative on direct smear and culture (culture done for A. and K.F.B.).

As the progressive diagnosis was uncertain, treatment was initiated with prednisone 20 mgm/day and the three primary lung tuberculosis drugs. In December 1961, he had an attack of left basal pneumonia, was admitted to hospital and treated with penicillin and physiotherapy with good result. A bronchogram at that time revealed right and left bronchiectasis. By August 1962 he complained of fatigue and dyspnea on exertion—he was unable to keep up with his fellows when playing football. When treated in October 1962 it was decided that there had been little change radiologically in the past year disease steroids and antituberculous drugs then was discontinued. He was then transferred to the London Chest Hospital for further investigation.

On admission he was found to have a few fine crepitations at both bases otherwise no abnormal clinical findings. R.F. 14/175.

Investigations: Chest X ray showed well-developed lung shadows throughout both lung fields. The left lung rib showed a spade appearance. Hb 90%; W.B.C. 15,000. Polymorphs 80%. E.S.R. 14 mm/hr. Serum Albumin 3.6 Gm/G. Serum Globulin 2.6 Gm/G. Serum calcium 10.0 mgm/l. Liver Function Tests: Bromsulphthalein Test and Prothrombin time normal. X ray of skull and hands normal. E.C.G. showed partial R.B.B.B. indicative of some degree of mild ventricular strain.

Respiratory Function Studies

Maximal Capacity 2550 (expected 2580). F.V.C. 1500 ml. Inspired and 1400 ml. CO uptake factor 77% (expected value 78%). A diffusion defect is present but occurs later on and PCO₂ not normal.

The diagnosis of sarcoidosis was questioned because of lack of response to steroids and absence of hilar adenopathy. The appearance of the left liver rib was also unusual. A routine needle biopsy was carried out and was normal.

On 16/10/61 a lung biopsy was carried out through a right thoracostomy. The lower posterior subpleural and on the cut surface there were discrete nodules. The right lobes were not involved. The biopsy report was as follows: The lung biopsy shows both small granulomatous foci and also poorly defined accumulation of haemocytes in the interstitium with a peripherally situated eosinophilic-sclerotic. Elsewhere there are areas of dense fibrous tissue which the alveoli are

abnormal). No capillary proliferation is evident. Some of the alveolar vessels show marked thickening suggestive of pulmonary hypertension. Scattered throughout the lung tissue and also within some of the bronchioles are pigmented granules and granules giving the Papanicolaou stain reaction and probably of macrophage origin. No legal was present in the small pieces of tissue available for fat analysis. The appearance is that of a histiocytic reaction—i.e. xanthomatous pneumonia of lung¹.

The patient after convalescing from the disease has been followed up at the London Chest Hospital, and when last seen in December 1963 he was well and there was no cough or sputum and he was not notably breathless.

Case II

R.B. Age 41. On routine X-ray was reported as: 'lungs clear, chest normal; in both mid zones a 3-6 cm obscure hilar gland enlargement' (See Figure 1). He was



Figure 1. Chest X-ray showing enlargement of hilar glands in both mid zones, as well as pleural thickening in the right lower zone and the left upper zone.

admitted to hospital May 1964 and was asymptomatic. 1 drop of sputum in the last month with morning macrophages, cough after the last cigarette of the day and fatigue for one year. Weight steady. Smokes 20 cigarettes a day. No unusual exertion or labours. No relevant past, family or contact history.

On admission the only abnormality on examination was a post chest movement with expansion of 4 inches.

Re-examination of previous X-rays shows early evidence of nodding in May 1962 (See Figure 1) although raised at the time, as noted, but X-ray November 1962 was clear.

Early haemoglobin 156 g/l, WBC and Differential normal. BSR 9 mm/hr. Maximum 110 000 polymers. Sputum and Gown, sputum fluid reported on direct smear and culture for A. and A.F.B.

Serum proteins and electrophoretic pattern normal. Serum calcium 9.9 mg/dl, W.B.C. negative. Liver Function Tests normal. C.V.D. normal. I.V. in normal physiological limits of normal.

Pulmonary Function Studies

Wright's Peak Flow Meter Readings—400—440—410 litres/minute, which is low for a man of this age and build.

Vital Capacity—4100 ml. After bronchodilation—4190 ml.

F.E.V.₁—1940 ml. After bronchodilation—2010 ml.

$$\frac{F.E.V._1}{V.C.} \times 100 = 50$$

V.C.

O₂ diffusion capacity: At rest 11.6 ml/min./mmHg (Min. vol. 9.7 l./min.)

On exercise 13.7 ml/min./mmHg (Min. vol. 16.5 l./min.)

Report

Respiratory volumes at lowest end of normal scale with no improvement following ateloid Absorption. Diffusion capacity somewhat below normal at rest and in spite of considerable reserve in minute ventilation on exercise there is very little increase in diffusion capacity. Thus there is ventilatory loss, also there is definite loss of diffusion capacity although no evidence that fibrosis has developed to any extent.

This patient has been included in the care of his local Chest Clinic for follow up. The condition has now been present for almost two years and has not progressed in the past eight months.

Discussion

The two cases described above were both picked up on annual routine chest X-ray. Both were almost asymptomatic and there were no clinical signs on examination. There was nothing of interest in their family histories, previous medical histories, previous exposure to places of confinement. Both were considered as the first evidence to be suffering from either variations of tuberculous, atypical lack of hilar adenopathy radiologically. In Case I the Mantoux 1:1000 was negative, while in Case II the Mantoux 1:1000 was positive. All other routine investigations were negative. There was complete failure to respond to anti-tuberculous drugs and steroids, after one year in Case I and six months in Case II. Both patients were then referred for thoracotomy and lung biopsy when the diagnosis was confirmed.

The course of the condition confined to the lung should be questioned. In presumptive cases of tuberculosis or carcinoma without hilar gland enlargement, and in which there is pulmonary granulomatous lung biopsy should be carried out, as a likely first step, cause of primary pulmonary sarcoidosis, granuloma will be diagnosed.

The frequency of the association between the pulmonary frequency of diagnosis of heart failure is due to the high incidence of thrombosis and lung disease when the diagnosis is made at the 40th percentile, being the only serious way of establishing a diagnosis. It is known to occur mostly in white males between 20 and 40 years of age. Although 3 cases were described in Negroes recently by Diamond (1964) in a limited Negro hospital population and he suggests that the reported rarity of this disorder in the Negro is only relative. His data point out that in pulmonary thrombosis, pleurothorax there is essentially an isolated myocardial lesion on casual observation as in Case 1. The course is self limiting in a few patients with pulmonary involvement of varying degree, in others it is progressive with acute pulmonary failure and cor pulmonale. First deaths have been recorded so far, but in the follow up too, only been for some years, the ultimate outcome is uncertain. Many of the cases suffer from considerable disability, all seven cases included in the lung described by Lewis (1964) is recognized as varying degrees.

The course of the present case was followed by physiological studies from 1959 when Goldstein, Cates and Gardner (1963). The most common findings were those of alveolar capillary block with well maintained breathing capacity and variable dysfunction in lung compartments, and reduced diffusing capacity of the lung. Both of the above patterns confirm to these findings as demonstrated in their pulmonary function studies. Clearly not specific pulmonary lesions may be a consequence of non-specific processes. Occasionally syndromes which follow the lymphatic, character of the lung is diagnosed as local infection, but in certain cases (especially and being confined to the lung appearing within a reasonably period of time could quite well be secondary to pneumonia in some cases.

Syphilitic pericarditis has been reported in 20% of patients with coarctation, pneumonia. Fennel and Lubow (1954) have found local changes suggestive of the disease in apical lobes situated from extensive healthy subjects with syphilitic pericarditis. From this they concluded that some patients with syphilitic pericarditis may represent focal lesions of atherosclerotic pneumonia. These lobes were observed at autopsy in Case II.

Pulmonary coarctation, pneumonia is generally a benign condition, the onset is insidious and the course marked by slow progression followed by regression or prolonged periods of no clinical disease, although cases have been reported being actually of with severe respiratory insufficiency (Anderson and Fowler 1954) but with good response to high dosage of steroids.

The aetiology is unknown, but speculation on an altered amount of golden brown pigment granules associated with the lesion was raised by Adams and Schatz (1963) who observed this phenomenon in many of their five cases. These granules do not give a positive reaction to Papanicolaou although they resemble melanin in this as present in Case III and probably Case I. Although the latter gave a positive Papanicolaou reaction, the patient had spent a considerable time living and died (as long as part of his occupation).

In case of certain features, however, an aetiological origin is a possibility and has been described in Auld's paper (1957). The various changes and some atherosclerosis are frequently associated with diseases of known aetiology, pathology and the tendency

functionally, in location, cellular composition, degree of anaplasia. Osmond and Parsons (1949) must have missed the very different type of carcinoma which arises from alveolar bronchioles, alveolar gland carcinoma or adenocarcinoma, a gland carcinoma of the lung type. Primary carcinoma from bronchioles characterized by an infiltrative growth despite isolated lobules, infiltration of lymphatics, veins, etc. (Lung 1951; Leakey, Leakey and Parsons 1952).

Differential diagnosis requires consideration of all disease processes which may produce granulomatous reaction in the lung tissue and some clinical and laboratory findings are more or less negative and is limited to a differential diagnosis—rare radiological appearance. This is described by Ariens et al (1957) as a benign disseminated process of histiocytosis type spread with granulomatous reaction without necrosis. The granulomas are superimposed on a background of interstitial fibrosis and alveolar emphysema. Therefore the following must be considered and excluded if possible sarcoidosis, tuberculosis, pneumoconiosis, bronchiectasis, Hodgkin's disease and other lymphomas, histiocytosis, eosinophilic pneumonia, sarcoidosis, polyarteritis, anemia and Leukell's syndrome.

Treatment with corticosteroids, ACTH and steroids have been tried with varying success, no doubt due to the fact that the granuloma reaction spontaneously resolves, satisfactory for long periods or very successfully progresses to diffuse interstitial pulmonary fibrosis with air pollution. Success has been claimed for radiotherapy, but this method of treatment applied to a diffuse condition of the lungs carries the risk of radiation pneumonitis and atelectasis.

Pathology—the gross appearance is similar in the majority of cases. The lung surface here, a granular appearance and as, similar to pneumonia.

Microscopically there are focal collections of mononuclear and histiocytes, some with associated lymphocytes and some containing golden brown pigment. Small collections of lymphocytes and occasional multi nucleated giant cells. Gold (1957) reviewed the pathology and proposed the following sequence: a focal interstitial granuloma associated with a proliferative, inflammatory and the carbon clump. The alveolar structure was preserved but with progressive the bronchiolitis, alveolar ducts and septa become involved by histiocytic proliferation. Necrotic destruction occurred and secondary emphysema developed. The alveolar structure led to loose connective tissue formation of communicating vessels. Expansion of these vessels could fill, plug and eventual pleural rupture occur accounting for episodes of spontaneous pneumothorax. Gold further stressed that all stages of the disease process may be found in one specimen of the lung and noted that inconsistent destruction and repair take place. He concluded that recurrent fibrosis does occur and wondered whether varying incidence of pneumothorax, clinical of spontaneous pneumothorax associated originally with eosinophilic granuloma (Simpson (1954) has shown that this is true.

Primary pulmonary eosinophilic granuloma is one cause of the radiological condition known as lung first described by Osmond and Parsons (1949). The acute radiological appearance occurs in eosinophilic granuloma of bone and with acute skeletal osteomyelitis. Osler (1956) states that may occur in association with this condition. The primary pulmonary case has not been described in detail in

but is always associated with some pulmonary involvement. Other causes include Latent-Tuberculous infection wherever blood-borne Chlamydia disease today carries on infancy, convalescence with renal involvement, and infection.

It is appreciated that the two patients described in this paper have not been followed up for a sufficiently long period (14 years and 2 years) to know whether there will be some or solitary involvement at some future date. At present in both cases there is only evidence of lung involvement. Whereas in many of these cases the process begins small and there may be considerable residual fibrosis leading to our granuloma. The process is unlikely to be affected by treatment but steroids should be used if there is evidence of further progression.

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My grateful thanks are due to Surgeon-Lieut. Edward E. M. Hollett, CE, DFC, CBE, for permission to publish these notes.

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A CASE OF INTEREST

By Surgeon-Commander (Dr R. R. C. Chell, Royal Navy

This patient in his middle thirties presented complaining of a sore taste (like stale wine) in the posterior (basal) region of his tongue.

Examination of his teeth and tongue revealed nothing abnormal except for an ill-fitting gold crown on an upper incisor showing there being a large palatal defect. An X ray of this tooth showed a periapical area of infection.

ES and T. exams were that there was no abnormality present, but response was still against the crown in the cause of the patient's symptoms.

Treatment. The periapical area of infection was resolved and the tooth crowned.

On review the patient stated that his symptoms had completely subsided on increasing the intake and a year later this cure still holds true.



Diagram of Tongue Showing Taste Areas.

Conclusion. This was, although of an extremely simple nature, an old remedy owing to the patient's insistence that the origin of the taste was in the posterior region of his tongue.

My thanks are due to Surgeon-Reader Admiral R. D. Caldwell for permission to publish this case.

A CASE OF THYROTOXIC PERIODIC PARALYSIS

By Doctor Robin A. R. Agnew (Formerly Surgeon-Lieutenant R.N.)

Spasms, spasms of muscular weakness occurring in association with a toxic goitre are rare enough to justify reporting. The connection between thyrotoxicosis and muscular fragility has been known however since Robert Graves' original description of myopathetic goitre, in 1835. Bouverie (1849) was also aware of the association and Charcot later it was to have noted the spontaneous disappearance of Graves's paraplegia for paratyroid attacks of paralysis in the lower limbs, occurred in most of toxic goitre (Dunlap and Kaplan 1946). The attacks resemble the hypokalaemic form of periodic paralysis but there are certain differences which will be discussed later. Most cases of the thyrotoxic variety have been reported from Japan. According to Okumura (1937) the ratio of Japanese to the combined European and American cases reported in the literature is 7 to 1.

The condition appears to be uncommon in the British Isles. Brown (1937) states that he has seen only one example of the disorder. He comments that the prognosis is good as the attacks of paralysis are cured by thyrorectomy. This underlines the condition's importance not only to general physicians and neurologists but also to surgeons. Following the report of a case occurring in a 36 year old officer of the Maritime Medical Navy I reported briefly a further case (Agnew 1959). It may be of interest now to recount more fully the history of this patient, especially in view of the paucity of case reports of this disorder from the United Kingdom.

Case Report

The patient was 31 years old at the time he came under observation as a possible case of thyrotoxicosis. He was a serving officer in the Royal Navy carrying out indispensable ceremonial duties. Aggravate Watt was therefore considered to be the diagnosis when he was first referred with vague nervous symptoms in February 1959. His eyes had a slightly staring expression and protruding in two eyesightless, or lid retraction and the thyroid gland was not palpable. No specific treatment was given although he was advised to abstain from cigarette smoking.

During a warm night in 1959 when he developed sudden weakness of the legs, loss of power was felt mainly in the proximal muscles of his lower limbs though he could move his feet. There was no noticeable weakness in his arms. It continued the previous at 0400 roughly six hours after the onset of the attack and found that motor power had now returned to the muscles of the lower limbs, although the deep reflexes were diminished. There was a regular tachycardia and obvious tremor of the outstretched fingers. The thyroid gland was not palpable but subsequently over the next few weeks a small but definite, smooth goitre developed and he complained of excessive muscular fatigue on walking. Following the nocturnal episode of paralysis he was treated with 'Miltal Pot Cit' 30 M Eq daily and phenobarbitone 90 mgm daily.

On being questioned he admitted feeling 'stupid' about his condition. I, the personal member of the House Lords had only, like a common labourer, to count on my own resources. He had paid back, unwillingly, the whole debt on the following morning. He thought he must have been 'knocked out' by a stroke of apoplexy incurred between midnight and 04.00 and was concerned with regard to distribution of the paralysis. He experienced a further similar episode of not taking a day's sleep about a week prior to the next attack which in 1959. In subsequent episodes after a few minutes. He was feeling 'hot and cold' at the time. He was uncertain about the duration of the attacks at night as he went to sleep later in both instances but was quite certain that his sleeplessness was on the upper part of the legs and I could move my toes.

The summer of 1959 was, particularly warm and sunny in England and the classical signs of thyrotoxicosis in this patient became gradually more obvious during June. Interestingly there were no more attacks of periodic paralysis while he was being treated by the combination of potassium citrate and phenobarbitone. He was referred to St Mary's Hospital, London where the classical symptoms were confirmed by endocrine tests, but. After the usual pre-operative preparation a partial thyroidectomy was performed in June. The post-operative course was unremarkable apart from a single episode of nausea which responded to ipecac.

The patient has remained fit and has normal vision and at one including the laboratory tests. There have been no more attacks of muscular weakness and his only noteworthy illness has been glandular fever in 1964. This was followed by a feeling of lassitude for several weeks but he returned to full duty within a month.

Discussion

Blum (1955) has described the muscular disorders associated with hyperthyroidism as follows:

- 1) Exophthalmic ophthalmoplegia
- 2) Acute thyrotoxic myopathy
- 3) Chronic thyrotoxic myopathy
- 4) Thyrotoxic periodic paralysis
- 5) Myasthenia gravis associated with thyrotoxicosis

The clinical features of exophthalmic ophthalmoplegia are well known and its pattern obviously did not come into the category. Acute thyrotoxic myopathy is a very rare condition where weakness is described by some (Mallat and Warrick 1974). It is associated with exophthalmic ophthalmoplegia and a rapidly developing bulbar palsy the outcome of which is usually fatal within a couple of weeks. The main site wasting of chronic thyrotoxic myopathy which occurs characteristically in the shoulder and pelvic girdles and in the thighs is characterized and localized fasciculated tremors of the hyperthyroidism is followed by permanent recovery of the wasting. Hyland (1962) has recently carried out electromyographic studies on three patients with thyrotoxic myopathy and has suggested that muscular atrophy is a common accompaniment of hyperthyroidism. Muscular wasting may be severe even when thyrotoxicosis is treated.

In this patient, following an abnormal electrocardiogram, severe limb clonus (15, but weakness) began and continued 15 minutes before cessation. There was bilateral weakness and abnormal muscle wasting. It is possible that the period of observation by his medical staff of his hyperthyroidism may have been too brief for the condition to have had time to develop. Although electroencephalographic studies were not done and full proof is therefore lacking the case did not seem to be one of chronic myopathy. Latency was allowing for the fact that electromyogram was not used during any of the acute episodes of muscular weakness the absence of involvement of bulbar muscles is against a diagnosis of myotonia gravis. The association of the latter condition with thyrotoxicosis is not unusual but the symptoms are ameliorated by thyrostatics (Brown 1955). The typical onset of the attacks of paralysis at night during sleep and their sporadic nature in this patient accords with the descriptions of thyrotoxic periodic paralysis by other authors (Dunlop and Kepler 1931; Marcano and Levy 1952; Andersen and Rasmussen 1954; Aulien and O'Connor 1962; Frick 1964). These workers also refer to a further point of similarity in that the weakness was felt in the proximal muscles of the lower limbs which disappeared spontaneously.

The fact that no further attacks occurred following the administration of potassium is interesting in this instance has been well before in the prevention of attacks of familial periodic paralysis (Talbott 1941). According to this author a decrease in serum potassium is a constant finding during attacks of paralysis which may have either a familial or a sporadic form; the latter sometimes in association with thyroid enlargement. More recently it has been realized that the attacks may occur in a variety of clinical syndromes eg. primary hyperparathyroidism and potassium being depleted associated with alkalosis in the levels of intracellular and extracellular electrolytes (Katz and Marcano 1955; Kinsman and Mahapatra 1963). These workers investigated the serum and urine electrolyte levels during spontaneous and provoked attacks of weakness in 14 patients with typical thyrotoxic periodic paralysis and compared them with the corresponding levels between attacks. A marked fall in serum potassium level was a constant feature during attacks of paralysis. Between attacks these patients had normal intracellular water and potassium differing in this respect from the other patients studied who were suffering from thyrotoxic myopathy. The authors concluded that when intracellular water and potassium levels are found to be low in patients with thyrotoxicosis, myopathy is likely to occur but not periodic paralysis. They state that normal levels in a thyrotoxic male patient appear to be to a 50 per cent risk of developing sporadic episodes of muscular weakness. Unfortunately no estimation of serum potassium levels was made in this patient so the fact that no additional attacks of paralysis occurred prior to thyrostatics is of doubtful significance.

For permanent recovery from the attacks of thyrotoxic periodic paralysis the treatment must be complete (Barnard and Levy 1955). In other patients attacks continued after thyrostatics although with some lowering in severity. Frick (1964) has reported a typical case of the disorder in a 70 year old male engineer following the failure of medical treatment to control the attacks permanently.

three days later with just a brief feeling of numbness about the onset of symptoms. The results of the operation as described in patients say three months later but the period of follow-up is too short, to accept this as a cure. Green and Turnbull (1937) have described a similar discovery from hysterical periodic paralysis in a 35 year old man following the operation of 'subtotal' thyroidectomy. The period of follow up, however, was only three years. The Naird patient has been followed up for 4 years and has had no further attacks.

It is interesting to speculate on the relationship of the familial and dystrophic forms of periodic paralysis. Nagai and Gershbody (1931) and Acland, Allan, Castleden and Walker (1937) have reported typical cases of familial periodic paralysis in which the onset was invariably at night during sleep. This raises the question of whether there is a latent tendency towards the condition which is brought to light by the development of thyrotoxicosis. Wolf (1942) has taken the opposite view and postulated that hyperthyroidism developing in a patient with familial periodic paralysis is a compensatory mechanism. He advanced thyroidectomy as the prophylactic treatment of attacks and maintaining that the episodes of weakness may be related to relative insufficiency. This is worthy of note in view of the installation of his patients with one of the attacks of paralysis in the present case.

Mallory and Blaxter (1934) have reviewed the literature of the relationship of the thyroid gland to neuromuscular disease. They found that of more than 400 recorded cases of periodic paralysis with a positive family history, less than 50 had associated thyrotoxicosis. These patients with familial periodic paralysis appear only rarely to develop severe goitres. It is also known that a family history of periodic paralysis is very uncommon in those cases associated with hyperthyroidism (Olivares *et al.* 1937). It seems unlikely therefore that patients with the dystrophic form of paralysis have latent familial periodic paralysis which is made manifest by the development of hyperthyroidism. There are certain subtle differences between the dystrophic and familial forms of the disorder, which Engel (1941) has pointed out. In a review of the world literature he found 218 case reports of the former variety and of these 95 per cent were Japanese in origin. He drew attention to the fact that there is a higher proportion of males to females affected in the dystrophic type than in the familial variety, and that the age of onset is usually later than 16 years in the former in contrast to the earlier onset in the latter. He also noted that a family history of periodic paralysis occurred in only 2 per cent of the 218 dystrophic cases. In an effort to evaluate the latent abnormality in the dystrophic and familial forms of the disease, Engel gave 1,1-procainethiouracil and later thyrotoxicosis to a patient with familial periodic paralysis. The conclusive results appeared to confirm that there is a difference in the basic abnormalities in the two forms of paralysis.

It is interesting to speculate on the mechanism of the muscular weakness. Additional factors in the levels of potassium in the serum are almost certainly involved. Neuromuscular block dependent on an excessive potassium ionemia is a possibility suggested by Acland and O'Connor (1942). The explanation of why the attacks commonly occur during sleep (Dunlap and Repler 1934; Skerfving and

Lars, 1952; Anderson and Wigness, 1959; Aulic and O'Connor, 1961; Peck, 1964) is strongly and finally the suggestion that thymosin α is an autoimmune disease where the question of autothymic or the pathogenesis (Shibay et al. 1965). Further experimental work may throw new light upon the possible pathogenesis that occur sporadically in this disorder.

SUMMARY

A fresh case of thymoma, paraneoplastic parathyroidism is described. The beneficial effect on the parathyroid glands by surgical treatment of the hyperthymosinemia is noted. The length of follow-up following thymectomy with sustained absence of parathyroid in the longest in the Dutch literature.

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I should like to thank Mrs. P. Grooten who helped me with the typage.

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Articles

A NEW APPROACH TO PEPTIC ULCER*

By Surgeon Captain T. L. CLARK, R.N. (Retd)

PART I

In the opinion of the writer of this paper the most important thing that any medical man has to do in dealing with disease is to decide whether the human body is built wrongly or is being used wrongly. And in making this decision over individual diseases he should be guided on the one hand by the Darwinian evidence on human evolution and on the other hand by the tables of mistakes of human (compared) civilisations. The present article seeks to show the importance of this approach in the case of peptic ulcer.

Now even under artificial conditions that protect Nature's evils—the struggle for existence, which is the driving force in evolution—has produced a very competent defect exceeding 3 per cent live births! But the evidence of peptic ulcer amongst the population in north-west 20 years is given as this, and with this fact as a background to his thoughts, no one can long be concerned in the way also that, in the case of peptic ulcer, the human stomach needs too much of the aggressive hydrochloric acid or too little of the defensive mucus. Instead the seeking after truth will start to look for some new factor in the environment that is leading the hydrochloric acid to cause this great damage in the stomach and duodenum. In short he will stop considering that the body is built wrongly and instead will try to find out how it is being used wrongly.

Formulation of the Argument

In his quest the enquirer will be helped by the knowledge that the only component of food that contributes to its osmotic value is salt, the hydrochloric acid is the potent component. Fats, sugars and sugars do not affect the acid at all! Therefore, any obvious thing to look for is whether the potent component is being stopped in some way from the foods eaten today. Then, if it can be shown that this is in fact being done, and that the only people who develop peptic ulcers are those that eat these potent-stopped foods, a strong argument will at once be available for upholding the causation of the disease. That, as a method, is what the writer has sought to establish and will endeavour to summarise in this paper.

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Protein-Richness in Carbohydrate Feeds

It is almost solely in the carbohydrates feeds that the protein component is supplied out in modern cereal-based pastures. Examples are given in the following chart:

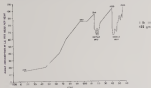
| Carbohydrate Feeds | Protein Component | Percentage of Protein to Weight contained in the Feedstuff | Percentage of Protein to Weight contained in the Pasture | Percentage of Protein to Weight present in the Pasture |
|------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|
| Wheat (about wholemeal flour 85%) per unit available | Milling and extraction to white flour 75% (as unit extracted) | 11.4 | 11.0 | 4.5 |
| Barley (wholemeal) only | Milling, 75% per unit extracted plus 25% plus milling plus feeding | Not known | 10.6 | 7.1 |
| Pea straw | Feeding plus feeding | Variable (about 4-14% per unit depending on the degree of shelling) | 10.5 | Variable, suggested figure 9.4 |
| Maize cobs | Feeding plus wholemeal extraction | Not known | 5.0 | 10.4 (approx.) |
| Soyabean | Extraction of solvent leaving the highest grade | 10.0 | 15.0 (approx.) | 10.0 |

It will be noted in the above table that the protein content is estimated on a 'dry' basis. This method of estimation is essential but the reason will not be discussed here as it deals with a far more work.

Protein-Deficiency

In the feeding of carbohydrates the feeding practices lead to increased consumption. It would seem that this is due to the fact that the constant concentration develops the taste buds in the tongue. This is well seen if the smooth, spongy nature of white bread be contrasted with the rough, starchy nature of wholemeal bread, but still eaten so if the 2 out of refined sugar is present consumed.

per acre/acre/acre) which per day in the country is converted with the 24 lb of meat loss or sugar cane, from which it is derived. Who would estimate that amount daily of the peasant subsistence? Is the only pt sugar the per in consumption following its refinement and commercial use actually be traced from the 12 lb per year in 1915 to the 100 lb per year of the present time, as can be seen from the diagram below?



This rise in consumption must be at the expense of other foods which normally would contain protein. In short the refining of carbohydrate foods not only reduces the protein content but also leads to a marked increase in the consumption of these stripped foods so that in protein stripping there becomes added *protein displacement*.

Consequences of Protein-stripping and Protein-displacement

In Western countries like ours where the total protein consumption is high neither of the above protein losses could probably have a marked effect on the maintenance of the protein pool were it not for two other facts of great importance:

1. The stripped foods are often consumed by themselves.
2. The various parts of a meal largely remain distinct in the stomach.

1. As regards the first fact consider any young couple as a couple. In its middle of the performance they are only too likely to consume some sweetened which will probably consist of almost pure sugar with practically no protein at all. The caloric value of this sweetener is high and will result in a considerable secretion of gastric juice. The consequences will be that the membranes of the stomach and duodenum are exposed to almost completely unbuffered acid often for several hours.

Very similar events take place on other occasions, too, such as during elevenses, when some three hours after breakfast the almost empty stomach receives a cup

of tea or coffee often heavily sweetened with sugar but with very little milk and therefore containing hardly any protein. Another example is provided by drinks of alcohol taken some time before meals especially at isolated parties. In all these cases the stomach is liable to be subjected to stress completely unbuffered and, often for a long time. In crowded quarters, therefore, these five examples, under the cloak of a respectably solid protein provision, a protein preposterous that it strains nerves of the day is seriously deficient.

2. As regards the second fact it cannot be argued that, while the protein values have been heavily reduced in parts of a meal, though the total protein content of the meal remains high the wine-driper is not pleased. It may be very much proved. Consider a meal where a plate of sheep kidneys on various coloured potatoes is finished, and a second fruit salad containing only 1.5 per cent of protein coloured follows the drink. It cannot be argued that the stomach will be adequately sustained in this meal. For the following considerations show that it will not.

In the first place, in any indigestible meal it is ring in one that every particular wave carries some part of the meal straight into the bloodstream. The first waves often fill the duodenal cap. It is not a fact that the stomach contents are cleared up all in even minutes usually, and then a pyloric valve is released and the whole meal projected onwards. In the second place, it has long been known to physiologists that the succeeding portions of a meal are arranged in corresponding layers in the stomach.¹ Now does drinking affect these layers of food in the stomach, once food has past the food and juice, the stomach almost immediately.² Veterinary surgeons have discovered that all the above applies to animals too.³

To sum up, it is obvious that there is a fundamental difference in the protection afforded to the gastric membrane by say 12 oz of protein food divided equally between three meals and the same 12 oz divided between two meals, as often happens in crowded quarters today, and of this fact it is admitted, it is possible to extend it, through the known occurrence of layering, just described in cases parts of meals. In short, it is contended that when it is insisted on the preservation of the integrity of the gastric membrane, it is not the total amount of protein consumed per year per month per day or even per meal but the amount of protein continuously present during the eating of any food—and that amount is never too small in any food as its natural state, since man has been evolved to be able to eat these foods with impunity. Removal or burning the natural protection of this protein during a meal (or part of a meal) by processing the food, and the narrowing of the stomach to the extent of its own total use are longer to succeed.

It may be added that the loss of buffering action produced by the removal of the protein element in carbohydrates can be—and has been measured.⁴

In the following sections it will be shown that the methods of peppy diet not only physiologically but also in the presence of war camps in Japan and Korea during the last war have contributed to the total protein consumption but does have a most serious relationship to the consumption of refined carbohydrates that have had the protein stripped from them.

PART II

Geographical Incidence of Peptic Ulcer—A Few Examples

Algeria. In Algeria the incidence of peptic ulcer follows very closely the consumption of refined carbohydrates. Thus in the Charles Lelong Memorial Hospital Algiers A. Bouché¹² records two cases of peptic ulcer in 25 000 in-patients over the past 10 years (1950-1960). These Algerian ulcers almost entirely on unrefined maize.

For example, the disease is just as common in the negroes in the US Army as it is in the whites¹³ though formerly it was rare in US negroes when they, like many,¹⁴ made their meal from sorghum meal. In many parts of colonial Africa the disease occurs frequently in typical form in Kampot¹⁵ and Nantou¹⁶ where refined carbohydrates are commonly eaten by Africans. The disease is common in Northern Nigeria too, where the diet includes large amounts of maize which as shown in the table given here, has lost a large amount of its original protein.

| Area | Population (1958) | Number of Hospital Cases of Peptic Ulcer (1958) | Incidence per 100 000 of Population (1958) | Percentage Increase Since 1950 Based on figures reported in these journals then | |
|------------------|----------------------|-------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------|------|
| | | | | 1950 | 1958 |
| Nigeria | 21 062 758 | 14 576 | 70 | 25 per cent | |
| Madras | 46 140 626 | 53 502 | 143 | 30 per cent | |
| India | 21 676 028 | 2 811 | 37 | 80 per cent | |
| Qatar | 11 615 545 | 4 152 | 28 | 30 per cent | |
| France | 23 868 812 | 2 150 | 9 | " | |
| Japan | 5 162 617 | 526 | 10 | 15 per cent | |
| United Provinces | 49,614 634 | 4 458 | 11 | 55 per cent | |

* Data mostly obtained by methodized ulcers and cancer.

India. In India peptic ulcer occurs only in certain regions, being absent in others. This ulcer belt is well known. The table shows how closely the incidence of peptic ulcer follows the consumption of milled rice.¹⁷ It is to be noted that the milling of rice leads to a loss of about one-third of the protein, whatever be the amount of the rice eaten and most of this loss.^{18, 19}

It may be added that peptic ulcer is commonest of all in the South Western parts of India, such as Travancore, where dainties are consumed. Nowhere does the evidence here, any relationship to hot climates or overeating.^{20, 21}

Japan. In Japan the consumption of refined carbohydrates in the form of milled rice and also considerable quantities of sugar reaches a very high figure—

and the incidence of peptic ulcer is the highest in the world (34.7 per 1 000 000 as against 14.1 in England and Wales!).

PART II

Evidence from Post-war and War Camps in the Far East (1945-50)

Extensive evidence on the aetiology of peptic ulcer is provided by data from the Japanese prisoners of war camps which as far as the writer knows, have not been used in the scientific field. In these camps the nutritional situation in the diet was very, and usually highly, varied, so that 'When little other food was provided the diet approximated, therefore, to that already described for certain parts of India and of the present treatment is correct, peptic ulcer should have become ubiquitous. For example, if the rice or other grain was not highly milled

and consequently it was not—then the diet approximated to one of unrefined maize or wheat provided not with very little animal protein, as already described for Africa and India, and peptic ulcer should have become rare; so means have evolved to convert the present to the past, or the diet or food deteriorate the general condition. The facts are as follows:

1. *Singapore and Thailand (Siam)* Here the rice meal was lightly milled but was supplemented by an amount of 10% *polished* and the end of 1943 when the rice meal. In 1944 polished rice which up to then had been infrequent, became as the result of Colonel Taylor's contribution to the 'Warrior' of the 'Second World War' a staple.¹

2. *Hong Kong and Japan* In Hong Kong the prisoners were fed on milled rice and peptic ulcer was prominent. However, after two years a large proportion of the prisoners were transferred to Japan itself and here an important change occurred in the diet, the prisoners being given rather a mixture of unmilled grains (including barley and millet) or fed (sometimes) rice. On this diet peptic ulcer for practical purposes vanished, no case being seen in Tokyo in some 5000 prisoners for over one year, and only one case being seen in Kobe and Osaka amongst some 10 000 Japanese prisoners during the same period. Meanwhile in Japan itself, where the population was largely fed on highly milled rice, the incidence of the disease quickly doubled.²

It may be added that during the above period Tokyo was almost completely destroyed by the US B-29, and extensive damage was done to Kobe and Osaka. In the case of London and other English cities a big rise in perforated ulcers occurred³ which is an striking contrast to what happened in the Japanese camps. These clearly are differences cannot be explained by any direct or direct argument, whereas it is easily possible to explain it by the present argument, since packaged confectionery and other refined carbohydrates were just the type of food that was largely consumed in the shelters in the United Kingdom, where rationing had not yet started.

3. *Death Camp Bodies*. The Japanese prison camps in this area were investigated by a Danish medical team in 1945-46, sent out by the Netherlands Red Cross, a full report of whose findings is published.¹ In this report the rarity of paper underwear is noted—these prisoners were nearly all fed on rot moulded rice.²

It will be noticed that in spite of other variables in these camps, which tend to cancel each other out, the thread of relationship between the incidence of scurvy and the consumption of refined protein stripped carbohydrates runs unbroken through all of them, just as it was shown to do in the preceding studies on the geographical incidence.

PART IV

Various Other Considerations

This part would normally be devoted to showing, first, that evolutionary factors indicate that a paper skin is necessary in the animal world, and that it only becomes a prison when it there is a delay in its normal development. But the highest evidence are reached in the full accounts of the results of depression and BATH in the scurvy animals³; for that eating food without any real desire (appetite) leads not only to a delay in the growth, emptying, time⁴ and that this is the mechanism by which "diet depression paper skinness"—i.e. by the scurvy leading to a fall in the appetite which because of habit and other circumstances is not accompanied by a partial reduction in food intake, consequently regression and accumulation of acid takes place in the stomach.

However, there is no space to pursue these three subjects here (which are fully discussed in the main work) and we must instead consider attention to the important subject of heredity.

Wounds and Paper Skin. In order to appreciate the part played by heredity in the condition of paper skin, it is desirable first to examine certain allied conditions which are of help in this connection.

As a start, consider the following statistics against enemy prisoners in the First World War of 1914-18. In this war it was found, as would be expected, that during these months full men were shot down by machine guns considerably more often than stock men were. Yet so our looking at a full man killed in this way would have considered the death due to a structural defect in the body, since in natural circumstances the full build might have been an advantage, not a disadvantage. No, the basic cause of death clearly lay in the new environmental factor of fire travelling bullets, in which no adaptation could yet arise and in which the man's build made him especially vulnerable.

Consider again the case of battle's vulgar. It is common to find men of full size go into them, that are two pointed, and yet only ten of them may well develop the battle vulgar deformity. These legs here are not built wrongly. For from it is pointed by them they might, in fact, be particularly efficient in certain unusual circumstances, such as on long marches or during jumping from one part of rocky ground to another. But the build of these legs through perhaps

refined carbohydrates were still in plentiful supply and on the other hand peasant wheat, even various kinds were occasionally branched, such when cereals and cereivivis entered regional life, so that many untreated meals were consumed. Later when these refined carbohydrates became scarcer and the men got more accustomed to Army food, the incidence fell considerably though it never became very low.

It was therefore a source of amazement to the German medical authorities that peptic ulcer in their troops on the eastern front became a rare disease. Through the incidence rose all the way back along the supply lines to Germany itself. There are many references in the subject but they are all marshalled in two masterly papers by H. Glaser^{1, 2} who was himself medical officer of a combat regiment on the front. The present author is deeply indebted to this authority, not only on account of the papers themselves, but also for valuable personal communications.

For the remarkable disappearance of peptic ulcer an explanation is immediately possible in accordance with the argument presented in this paper. Because, owing to the great difficulties on the supply lines, the German troops were forced to eat whatever local produce they could lay their hands on. As that they were able to eat stocks of grain left behind by the Russians, which were consumed in the earliest stages, but later the only local food available was that left actually growing in the fields, and this consisted mainly of turnips and potatoes. These were eaten largely uncooked. "The turnips were taken out of the earth and after severely being steamed, were eaten raw, and the same was done with the potatoes after having parked." In short, the disappearance of peptic ulcer was accompanied by a big replacement of refined carbohydrates with unrefined ones.

Furthermore peptic ulcer became very rare also in the German prisoners captured by the Russians. Thus W. Baumann, one of the greatest German authorities on the subject, in whom the author was indebted by Professor Glaser, has been kind enough to send the following personal communication (1945) —

"I was a prisoner in Russia from 1941 to 1945. In several of the 11 camps in which I was detained I systematically recorded the symptoms of peptic ulcer. (Many examinations are being made at intervals. In other camps I asked the surgeons about their diagnostic methods, findings and prognosis. For though they were of the type you I mentioned in your only, fewer amongst many thousands of prisoners — and there was more than one of the various kind of prisoners but included in the same hospital, and treated under food when we did. After they placed under 12 food who had suffered from typical ulcer before captivity, but had been free from it in the Russian camps, captured on other dates or later on).

In answer to your specific question: Our food in the Russian camps did not consist of refined foods but of unrefined wheat, oat, barley in stews, with frequently up to six per cent of pure lard as very heavy. Animal protein was almost completely missing, as we had no milk, cheese, eggs or meat. The nature of the was extremely varied. Since I was I produced a few (only 10-20) potatoes.

An explanation for the complete lack of a disease under such conditions, generally as unrefined uncooked German food, I could not find. I should be very grateful if you could let me know any of your views.

To sum up these statements it is clear that the freedom from peptic ulceration in these prisoners of war in Russia, due to diet consisting essentially of unrefined carbohydrates and practically nothing else, accords perfectly well exactly the same freedom in the prisoners of war in Japan at the other end of Asia, the only difference in the latter case being that the unrefined grain was mainly rice.

PART VI

Application of the Present Argument to the Prevention and Aims of Fasting Diets

The medical treatment of peptic ulcers, from the evidence set out in this paper, will now be seen to be an almost exactly the opposite type of diet to the orthodox diet commonly prescribed in hospitals. These latter diets scarcely force people to disregard their appetites, and keep their stomachs from ever emptying, so the question arises: does the reality of the stomach contain as pressure in the empty stomach whereas, as used in a patient on the full stomach, during the height of digestion? These diets thus induce people to eat refined carbohydrates in the mistaken belief that stress foods upon the stomach membranes whereas what occurs these membranes is not stress foods at all but unbuffered acid. In fact, instead, stress foods on stress signs the living membranes of the stomach then they do the living membrane of the mouth and provided they are properly mineralized are, on the contrary, very safe foods because of their high buffering power.

The orthodox diets have collected much criticism and quite rightly so when they fail to prevent the incidence of 10,000¹ stomachs annually in the operating theatres of England alone. It is therefore submitted that there is every reason to change to the diet that William Howell advised us — the one in fact, that is followed by the whole of nature, with the exception of civilized man.

This diet may be described as the following of natural instincts on natural foods. Both components of the rule are equally important. Eating natural foods that one does not want achieves little and eating unnatural foods that one does want achieves nothing less.

Natural foods are considered to include any foods that have not been altered from the manner in which they grow, but by simple cooking for which mankind has now become content with a type of approximately half a million years' and this no pressure comes down to any foods except the refined carbohydrates — white flour and the ordinary sugar sold as 'granulated' sugar and all the foods containing them. These foods as already shown, have only very recently appeared on the planet, and no comparison to them has yet occurred.

The actual practical details of this diet have been set out on a printed card and are available to anyone who asks for it.

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THE TOXIC HAZARDS OF FOOD

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Paper read to Association of Kent District Medical Officers of Health

Introduction

I would like to continue for outlining the scope of my talk. Firstly as a mere disclaimer addressing an audience of expert bacteriologists I have thought fit to exclude the aspect of food hazards caused by bacteria, firstly to discuss those hazards which are due to foods in their natural state followed by those which may develop due to processing and preparing foods and then go on to a consideration of the dangers inherent in the presence of chemicals in foods. This group readily subdivides into two categories—chemicals added deliberately and those which permeate or contaminate. Finally I would like to say a few words about disease hazards related to food and economic conditions.

Natural Foods

The food of man consists essentially of the products of the animal and vegetable kingdoms and it is strange that there is a tendency to say something for certain products to be considered entirely suitable for food and others entirely unsuitable. Quite obviously this is an over-simplification for life is never as simple as this. We know as fact that many of the most poisonous natural materials may be used beneficially in foods, while going to the other end of the scale is thing very food which is completely lacking in potentially poisonous properties. Perhaps not for one word of a statement that can be a dangerous material causing hepatic damage. A number of the staple commodities, foodstuffs which contain poisonous substances as we shall see later. Does this not mean that we must look more critically at many of our accepted foodstuffs and assess what risks we are running in their consumption and compare those dangers, probably small with those which today we are deliberately creating. It is in various quarters felt that too much attention is given to the latter and too little to the former. However that is largely a matter of opinion as to whether or not to take a look at some of the natural hazards.

It is hardly necessary to mention plants which contain potent alkaloids and the chemical case where the home-made corned beef lacking in bacteriological knowledge dug up sprouts instead of home-made and killed off the entire family at table.

It is of course also well known that the potato can become poisonous even readily as if turning green and sprouting because under these conditions the glycoalkaloid solanine develops to a marked extent. On the other hand we can venture that the daily ingestion of small doses of solanine is without effect. An acute case of solanine poisoning was reported by Dr. Wilson in the *Lancet* in the history of South Wales in 1950 where there was no evidence of sprouting or chlorophyll formation.

Another staple food in some parts of the world is the bean *Lathyrus*. This is eaten in more than about 20 per cent of the diet given rice, due to the presence of

number of the bacteria ($\times 10^6$ bacteria in ml.) (1) is considerably greater than that of the commercial strain. It is usually less than 1000 units from the dairy except 20 per cent.

Antacids are known to control gastritis, and even the use of sodium salt may not be effective in preventing the disease when much is eaten. It is interesting to note that the milk of cows feeding on bromine may also be gastric-antidote, and likewise it has been reported that cows when fed potato mash from a distillery treated refuse in their milk.

Many ailments cause interesting points. As long ago as 400 BC. Xanthophyl suggests that troops on their way back to Greece occupied in a mountain village near Lake Trebulum and finding their meals heavy they ate freely of it with the result that they vomited and suffered with diarrhoea and vomited above in blood or drunk. This was due to the fact that the honey had been collected from anakin the action of which causes indigestion. Never forget it is worth noting that while the sugar derived from the European tree is innocuous the pollen is poisonous but the bees appear to appreciate the fact and avoid collecting it, or at least are careful to brush it off before returning the hive.

Various aquatic animals can become poisonous by eating poisonous plankton. Well known is the case of mussels off the Pacific Coast of North America where a plankton of the genus *Chlorophyta* is responsible. Although the source is a relatively remote part of the world the possibility of such plankton occurring in our waters must always remain a possibility.

It would not be difficult to produce this too considerably. For instance, one could imagine that just as on the road of haddock with impunity but the fish is cooked later the oil of orange skin would appear to contain the highest fraction a carcinogen the consumption of a single serving has caused death and so on.

To return for a moment to water which we have already noted to cause hunger sickness it should be mentioned that the addition of high nitrate more than about 50 ppm nitrate nitrogen can be dangerous to animals when it is used for making their food. It gives rise to *methemoglobinemia* which has been fatal. A further possible danger with our present day water supplies comes from the use of synthetic detergents. These are not biodegradable in the sewage works and find their way into rivers which in turn are the source of supplies to other populations. It is felt that these materials together with the residues of plants etc. could promote the absorption by the gut of substances not normally absorbed or also increase their absorption. We shall come back to this point when speaking of emulsifiers and stabilizers.

The effects already mentioned are due in foods in their natural state. It would now like to turn to foods which have been prepared from natural products and have in the process acquired potentially deleterious qualities. I am here including those cases where additives are in question but confining myself to instances where changes occur in composition.

Even simple cooking can cause important changes in food. Baked and stewed fish have been found to have a 2-4 haemolytic content of 50 μ l. per kg. On the basis of it is said that one steak equals 700 cigarettes in the α , the content of 1.4 haemolytic in

concerned loss of certain flavor peaks of access to the body rather and so may the accompanying effect. As the same time the work by cooking including some of the natural aroma could especially if well cooked when some lipids would be lost. Smoked salmon and other smoked fish are also sources of 1,4-benzopyrene and obviously respect to cancer of gastric carcinomas.

The preparation of cooking fats and margarine from oils involves the process of hydrogenation. This technique causes the oil to become solid or approximately the melting point of butter. Unfortunately during the process the unsaturated fatty acids are rendered saturated or more so and this causes a loss of the EPA such as linolenic, which are now thought to play an important part in the prevention of cholesterol deposits in the arteries as well as protecting against cholesterol oxidation. It is claimed the process of hydrogenation produces trans instead of *cis* unsaturated acids, the natural form and that these block the metabolic processes of the body because they are not naturally similar to the EPA, to become incorporated in the membrane, chain but may incorporate cannot be processed.

While on the subject of fish and oils it may be well to mention that a good deal of work is being carried out to assess the effect of high temperatures on these materials when used for frying or baking. There would appear to be some evidence of the formation of carcinogens when fish and oils are strongly heated for prolonged periods and this would suggest care is required in regard to the preparation of fried food on the commercial scale. It does appear however fairly definite that smoked fish can destroy Vitamin B or possibly Vitamin A in the body.

Passing on to prepared drinks, beer contains alcohol, a carcinogen, while some may contain quite appreciable quantities of histamine, up to 22 ppm, and this of course would enhance the effect of the alcohol adding to the flushed appearance but more important, it can cause liver damage. It is interesting to note that the histamine derives from the bacterial naturally present which breaks down in the presence of heat, derived probably from such subhygiene, instances as blending grapes with beer, beer?

Chances on the other hand in certain so-called vitamin drinks such as Syntron derived from dehydrochlorinated vitamin acids. Amounts quoted are up to 162 µg/g. Theoretically at any rate the citing of citric acid could precipitate a cardiovascular accident.

Suffice it has been said. I hope to indicate that many of our foods, even our staple foods, contain three carcinogens at one time or another. I will therefore pass on to a consideration of hazards dependent on materials present in food but not natural ingredients thereof.

Chemicals in Food

You will remember that I subdivided the class of hazard into those which were added deliberately and those which passed across accidentally into foodstuffs. I should like to start by considering the deliberate additions. Those allowed by law require preservation, adulteration, adulteration and stabilizers and coloring materials. The Food and Drug Administration 1952 considerably widened the scope of preservation allowing for the first time the use of salts of propylparaben, and

unofficially reported, and a few, inadequately tested, and others, in a doubtful degree, might be taken as any of these materials with the possible exception of the benzoylurea. The only preservation that is likely to be present in foods and which may be considered a hazard is therefore reported to be both carcinogenic and toxic to the thyroid. It was at one time used quite extensively for treating oranges against mould attack.

The use of antibiotics in food is again to the objection that small doses may cause, in certain individuals, the drug and so it be in the system, it being possible at a later stage a resistant strain. In exceptional cases allergic reactions have occurred from drinking milk contaminated with penicillin. Tetracyclines are only allowed up to 5 ppm in fish and as they will be all or nearly destroyed in cooking but the subject of antibiotics in food is a general one of some importance. The use of penicillin for the treatment of mastitis in cows, can cause the appearance of quite considerable quantities of the antibiotic in the milk, if the cow is not kept off milk production until the drug is entirely excreted. The Ministry of Agriculture, Fisheries and Food's Report in 1963 revealed that 14% of our milk may to some extent be affected but since then the position has improved. The use of antibiotics in poultry and pig feeds is a more common commercial practice results in the flesh containing small amounts of the order of 0.1 ppm and the same applies to farm eggs.

Added to the problem of contamination is the development of resistant strains of bacteria and in the veterinary and medical world this is a problem of increasing importance.

The potential dangers are probably, with the exception of implanted hydroxy urethane, above reported. The same cannot be said of the emulsifier and stabilizer on the food colours. The former are usually considered undesirable on the grounds of allowing the passage through the gut wall of substances, not normally absorbed. For instance, substances normally considered harmless being completely unabsorbed, one in the process of three compounds pass into the blood and also the tissue where they are deposited in the cells of the liver and kidney producing serious damage. The same applies to mixing with certain of the synthetic food dyes, and as we shall see in a moment many of the permitted synthetic dyes are classified as the health hazard of class 1. At this point it may be worth mentioning that a particular danger is attached to the processed and, therefore, which these substances can bring about, is that the liver can be severely affected.

The list of permitted food colours was published in 1955 being based on the recommendations of two reports issued in 1944 and 1953 by the Food Standards Committee. In all thirty synthetic food colours were allowed, but a further report reviewing the position published last year indicated that only two of these colours, Amaranth and Green 4, could be accepted on the available evidence as safe for use in food. Eight others were given provisional clearance, together with one used by the European Economic Community but not in Great Britain (Black 79814). Of the remainder we were recommended for definite ban the remaining ten while in the case of other dyes sufficient or no evidence was available, to assess their suitability or otherwise. This would appear to be a very satisfactory state of affairs and when looked at from the international viewpoint some very serious situations arise.

coming in this, dye as, concerned Canada and the United States after Richard Hill PLP the European Economic Market Patent Blue V and Green Brown Blue VGL two of them are suspected carcinogens while the third is as yet an unknown quantity. It is very doubtful if any of such dyes having its own poison.

The major difficulty with dyes is a lack of toxicological data which in view of the possibility of carcinogenic properties if not in the dye itself at least in the metabolites in various. It is well known that certain azo dyes can react with proteins of the bladder and the chemical structure of many of the dyes is such that they could break down in the body to produce these potentially dangerous metabolites.

Certain azo dyes are a potential danger but certain benzene hydrocarbon dyes that are to be used in the food industry both of which may be converted into dyes in the other hand cause liver damage while P-4000 affects the kidneys.

I must now consider the very large field of agricultural chemicals. There may be grouped as pesticides insecticides, fungicides, herbicides, and weedicides and various others added to these. In a sense, they are not essential additives because it is expected that they will be eliminated before harvesting of the crop or slaughter of the animal for market.

The number of pesticides in use is now very large but for our purposes they can be broken into a small number of groups. Of the insecticides the greater number and more important members fall into the class of organic chlorine compounds, or organophosphorus compounds, with smaller groups comprising the diazinophenyl derivatives and the metal derivatives.

Recently concern has been felt in regard to the organic chlorine compounds in the presence of their persistence in the animal body since they are not wholly excreted but stored mostly in the fat depots. There would appear to be no reason for assuming toxic effects in their presence in the body although they may be excreted in milk, presenting a possible hazard to a nursing child in view of their greater tendency to all types of toxic materials. On the other hand sudden loss of fat either by starving or by disease, has been known to cause the liberation of such toxic materials into the blood stream to produce toxic symptoms.

The organophosphorus compounds present a far more complex picture in that they are many varying products on the market and being systems inactivated they are absorbed into the fat of the plant where they undergo transformation often to more highly toxic compounds than the parent substance. Fortunately they have a limited period of activity and if due regard is paid to their crops so limited should be transfer. If there should be any residue left on food it would result only as a temporary and slight lowering of the blood cholinesterase level.

The diazinophenyl derivatives on the other hand have had a longer period of usage as agricultural chemicals and in the 1930's in the United States they were used as domestic sprays since they stimulate the metabolic rate. Unfortunately such a use gave rise to cancer in about 1% of the patients and no use was discontinued. The fear therefore must remain that repeated small doses in food could have the effect of unacceptable values.

Of the herbicides in use the majority would appear to be without known toxic effects on humans or livestock consumption. A quaternary weed killer which

ground (114) and by this spillage. It has also been reported that *E. coli* can have a detrimental effect. In 1970 you may remember the United States government offered \$100,000 for a pound of *Escherichia coli* 0157 (contaminant of the material).

The fungicides and other agricultural chemicals containing arsenic are probably among the most dangerous chemicals as agricultural use. They could traces of arsenic can build up over the years giving the arsenically as epidemic. Even the use of a mercury treatment has been known to have fatal results. I distinctly some years ago examining just across a cow which the farmer had culled rather too rapidly and extensively with such an outcome.

Lead and arsenic from the use of lead arsenate often remain on the skin. I have such an apple and pear naturally in small amounts, tested the skin and color. This of course is undesirable both these metals being poisonous poisons which producing well known chronic effects.

On the subject of lead, I recently examined a number of Kent farm produced cydars in connection with supposed lead poisoning and found in some samples as much as 100 parts of lead derived from the use of a lead based apple spray. In this connection it is interesting to note that during the 18th Century lead poisoning was common in Devon is not being used 1770 that Sir George Baker pointed out that the lead based apple sprays were the cause. However, the metal cydars remain did not use lead based sprays as the disease was not known then.

The use of drugs in poultry to prevent disease and aid growth is now accepted practice and so with increases the number of such materials as use is available is increasing. They may be divided into three groups: antibiotics and compounds to aid rapid increase in weight and prophylactic drugs against coccidiosis and cataractophoresis. In this last group there are used over two dozen different drugs in use including some steroids. They are used in very small amounts in the feed, about 0.1% per cent — and as yet there would appear to be no reason to suppose that they produce toxic symptoms in the poultry or in man.

The use of corticosteroids on the other hand is not above suspicion. It is usual practice to place a pellet of about 10 mg under the skin of the neck and presumably this part of the body is discarded as dangerous but there are still reported as the material remains in the bird's flesh even after incision. The main danger being the possibility of the production of cancer in post menopausal women. On this point it is interesting to note various places contain information showing corticosteroid activity and this has affected sheep grazing on the alpine Trossachs Mountains, while women who in Holland during the war ate tulip bulbs were also affected.

The production of leucosis in fowl is usually in a relatively new field but one of increasing importance. Until the discovery of the antibodies associated with peritonitis would have not considered to be pharmacologically important with the exception of Eggs of *Rp*, but now we know that not only are antibodies produced by various strains of avian species but that when an under certain conditions produce potent toxins. I have in mind of course, the formation of a fasciitis by *Aspergillus fumigatus* as a contaminant. This toxin appears to be particularly dangerous to poultry and in 1960 many thousands of chickens were lost by what was then known

in Turkey X showed the resulting being associated with varying concentrations of Brazilian groundnuts. The level increased and the belt about often showed patches. This effect is not limited to insects but affects mammals as well and in this respect it should be noted that cows fed on commercial groundnuts excrete a toxin in their milk and ribs and ribs develop liver tumours. Although discovered as groundnuts the toxin occurs in a variety of other materials, for example coconut meat and cotton seed cake. For human consumption groundnuts oil can be made safe by an alkali treatment but with ground butter this treatment is not feasible.

The discovery of the aflatoxin has created interest in this field with the result that other mycotoxins are now known to exist. For instance, in Eastern Siberia an epidemic, distress resulting in stunted limbs and abnormal growth has been known for a century or more. It was thought to be due to the consumption of the rapeseed water but is now known to be due to contamination of grain by the mould *Fusaria sporotrichella*.

Similar results from mycotoxins occur in the rice growing areas of China and Japan where three species of *penicillium*—*penicillium notatum* and *stolonium* are responsible for food poisoning.

The subject of chemical contaminants in food would not be complete without some reference to the radioactivity of foodstuffs. This can be considered from three points of view: that naturally present in foods that acquired from nuclear bomb explosions and that which may be introduced by the use of atomic radiation in the preservation of foods.

Of the natural radioactive materials in food K⁴⁰, C¹⁴, H³ and S³⁵ are the most conspicuous and as man has always been subjected to their action, it is doubtful if he now suffers by their presence. That radioactivity added to our foods through atomic explosions represents an increase of only 10 per cent over the natural but unfortunately it includes radioactive isotopes of cesium 90 and 90. These because of their chemical similarity to calcium are absorbed into the bones and so it is possible that damage to the bone marrow may occur. It is particularly unfortunate that the 90 has a half life of rather more than 30 years in this means that its release increasing a given dose in the case of an herb will still have one-eighth of that dose remaining in the age of 70. Indeed, studies are in a more vulnerable position than other members of the community in that it is a dairy product which are the main source of this type of radioactivity.

For use in food processing gamma radiation from cobalt 60 or cesium 137 is used, or the electron beam gamma ray 'machines'. The doses are generally small so large amounts tend to produce unpleasant flavours and colour changes rendering the food unacceptable. In lower doses than those required to produce sterilization the technique is useful for the prevention of sprouting in potatoes, to retard growth of moulds, pests and dried eggs of radioactivity. In the United States it is now used to sterilize animal tissues for the animal factor. It would seem unlikely that treatment at the levels normally used would reduce radioactivity in the foods but the continued use of such a technique should be subjected to careful control.

Unbalanced diet

My first (happy) career was as a social and economic factors as they affect diet. To emphasize the importance of this aspect of the subject I should like to start by quoting Professor Yudofin (1964) who has said: 'In the study of human nutrition the social sciences are as important as the natural sciences.' Also he stated on this point for something like a million years, during the greater part of which he has been a hunting animal living mostly on flesh which goes to, considered by normal diet, it is only in the past few thousand years since agriculture has developed that a change in diet has occurred and cereals have become a significant factor. The production of agricultural crops means that larger populations could be supported than in a purely hunting community but the step from this has taken it was impossible to return to the former diet as in those circumstances sufficient food would be available in a variety which was restricted which ended in primitive communities showing increasing tendencies to rely on domestic crops as their diets died which, animal protein was easily obtainable. This pattern is still clearly seen throughout the world: in Europe we have our bread and potatoes; in parts of North America maize is the first crop. This lowered diet brings with it the risk of deficiency diseases either from lack of essential vitamins or essential amino acids or fatty acids. The incidence of beriberi and pellagra is too well known to require more than a mention.

Coming back to this country, there is little doubt our present economic conditions would allow the possibility of providing all the population something of a varied mixed diet. Indeed it is probably true to say that these conditions proved for the first time in our history. Today the general section of the community affords almost as much animal protein, the most expensive food generally, as the richest, whereas in pre-war years the figure was less than 50%. Everything therefore should be very satisfactory but in fact it is not so. I am sure you are all well aware. The sugar in the staple would appear to be the food manufacturer. All the time he is producing sugar soft foods which because of their general appeal are bought by the public in preference to more essential foods. Even the most gluttonous has a limit to his or her capacity and these foods containing often fat and no cream, soft drinks, sweets, chocolate are highly palatable and are taking the place of animal foods, fruits and vegetables to the general detriment of the individual. It is interesting to note that our sugar consumption per head is now 25 times what it was 200 years ago and about double what it was in 1850.

This power to be able to buy more food than is essential puts a considerable temptation in the way of many people and often results in over eating and an overweight body. This in turn predisposes to coronary heart disease, diabetes and dental caries. It is thought that the rapid absorption of sugar into the blood stream going on to a relatively high blood level is damaging to the normal biological mechanism for dealing with blood sugar and again there appears to be a clear connection between the incidence of coronary thrombosis and sugar intake rather than fat consumption as essential fat. These views may be controversial but I am sure it is true to say that over general provision of daily caloric intake with the over weight pattern and that of all the medical dietary problems in the country, this is an outstanding one.

Conclusions

It may be said that many years have seen a marked development in food processing techniques. These developments have often attracted the attention of consumers to our food but in this country at least such attention has only been restricted after careful consideration by the Food Standards Committee and similar bodies. Agricultural chemicals are not so regulated but here I believe one must accept the possibility of slight contamination of our food by possibly toxic materials in the interest of the production of the maximum amount of food in a generally underfed world. At the same time it should be remembered that there are Government sponsored schemes for the control of agricultural chemicals in which all responsible manufacturers participate.

More attention is being given to the natural composition of foods made possible by recent developments in analytical techniques and it is in this field that perhaps we can hope for important developments in the coming years — already the British Industrial Biological Research Association has indicated the way. Until far more detailed knowledge is available over the whole field many problems associated with diet must remain unsolved but at the same time one must be thankful that a body like yours is able to cope with a great variety of potentially toxic materials.

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UNEQUAL GROWTH IN THE LOWER INCISORS IN A SINGLE RABBIT BLACKIE

By Sergeant Captain R. W. E. Sharkey, RVN

The original purpose of this study was to obtain information about incisor growth rate in the teeth of old rabbits for comparison with results obtained after growing experiment 90. It had been found that while experiment 90 was incorporated into the bones of old rabbits to a less extent than in youngsters where bones were still in a state of active growth, in the case of teeth the position was reversed (Sharkey 1946a). Indeed, with careful design, the dental apical was accurately measured with age. Since it is known that experiment 90 incorporated by the teeth is almost proportional to the rate at which calcification is taking place (Sharkey 1946b) this suggested that the teeth grow up fast in old rabbits as they do in young ones or even faster. The results not only confirmed that the rate of eruption was maintained until extreme old age but also showed unequal growth between corresponding adjacent incisors.

Records were kept of lower incisor growth in an old rabbit, Blackie, from July 1 1964. They began July 27 1960 and continued until his death on September 22 1964. He was given W.B.C. from 18 until May 1962 and Conny Bland thereafter. Food and water were supplied *ad lib*.

Readings were taken every three weeks. A small mark was made on the lower incisor near the gingival margin and the distance measured in the previous mark which had advanced towards the front edge during the intervening twenty-one days. Single readings were of no significance by themselves since they depended on where the marks were made on any given incisor. Nevertheless, in the aggregate they were usually consistent (Table 1).

| | | Annual growth (mm) | | Daily average | |
|-----------------------------|------|--------------------|------|---------------|------|
| | | Right | Left | Right | Left |
| 27 July 1960 (27 July 1964) | 1961 | 87.7 | 87.4 | 268 | 255 |
| — 1961 | 1962 | 89.0 | 77.6 | 262 | 199 |
| — 1962 | 1963 | 76.5 | 70.5 | 204 | 175 |
| — 1963 | 1964 | 67.3 | 61.1 | 200 | 187 |

The results show that the rate of eruption was constant in the right incisor and slowly decreased with age in the left incisor. This would appear to contradict the idea of general uptake continuing with age except for the fact that the maximum dimensions of the teeth was increasing all the time. Thus a constant or slightly reduced rate of tissue growth could still represent an accelerating rate of mineralization.

Discussion

There are differences of opinion as to whether the rate of growth in teeth of continuous eruption depends on the rate of wear at the mesial edge or whether

the rate of tooth development, the rate of growth. Abnormal growth rates in experimental studies have been achieved by a variety of means, e.g. dietary changes (Harris 1959), sensory deprivation (Taylor and Butler 1951) and/or shortening of the day (Harris). And in spite of differing procedures, all these methods share a common feature. To some extent or another they all affect or are affected by the rate of eruption at the biting edge of the tooth concerned — otherwise toothache, severe pain, severe disorientation causes variability on the part of the animal in reception and level within natural strain. Artificial shortening periods accelerated eruption and so on. In circumstances such as these some teeth may erupt quicker than others but they will all erupt quickly enough to maintain themselves in occlusion. Hence the growth rate exactly compensates for what at the natural surface or oral corner.

In the present example the abnormal rate of eruption was spontaneous and permanent. It was probably due to the particular formation of the tooth themselves. The right incisor was a normal slender, sheet-shaped tooth, narrow at the anterior posterior margins, with a long delicate fovea. The left incisor was a more than compact tooth with enamel on two surfaces, banded to the apex of a triangular ridge. It banded thicker in some sections as later noted by. As it increased in bulk, its linear growth declined from an average daily rate of 525 microns in 1963/4 to 150 microns in 1967/8. Linear values for the right incisor over the same period were virtually constant.

Under similar conditions of wear the lighter tooth was always shortened more rapidly than the heavier one and stopped in occlusion by making correspondingly faster growth.

It is the first time the sequence of events has been reported except when it resulted from some artificial stimulus, and since the conditions of wear and tear were the same for both teeth, they seem to be consistent with growth rate being dependent on direction.

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THE KALAFRANA INFANT RESUSCITATION TROLLEY

By Joseph Comanador B. Booth, RN

Each year in Britain no less than 15,000 infants are stillborn or fail to survive the first week of life (Perinatal Mortality Survey). Nearly 3,000 babies are born alive but succumb within the first 14 hours following delivery. In the greater number of these cases death can only be attributed to asphyxia and post-mortem examination is inconclusive. It is estimated that 2,000 asphyxiated deaths are potentially avoidable.

Many babies could be saved by active resuscitation but this must be carried out within the minutes of birth, not only to offer the best chance of survival but also to ensure that there are no subsequent ill effects from prolonged neonatal asoxia.

Improving standards of ante-natal care will enable most normal infants to reach term, but the safeguards for the survival of the newly-born are still inadequate. Asphyxiated infants born at home have less chance of recovery than those delivered in hospital where resuscitation is not available and hypoxaemia is more common. Thus, there is an obvious need for portable resuscitation equipment designed for domestic purposes.

On the other hand those babies delivered in hospital who are asphyxiated at birth or who later develop post-partum asoxia should always have the benefit of immediate active resuscitation and periods of asoxia should be accurately timed. Furthermore the rules of neonatal hypoxaemia should be more widely accepted and the temperature of the newborn infant should be routinely recorded.

It is unfortunate that full scale resuscitation methods and apparatus are not universally regarded as being acceptable in domestic practice today.

Apparatus Previously Described

Commercial resuscitators have not available for any purpose and in short supply. The model described by Johnson (1959) and manufactured by Medical and Industrial Equipment Ltd. is a very useful streamlined model and having 3 ports can suit oxygen and suction provided. Positive pressure pulmonary resuscitation may be safely administered. The machine's suitability is based on the bag-mask principle.

The 'Resuscitator' Infant Resuscitation Unit made by Oxygonics, is well constructed and compact and the respiration table is equipped with controlled oxygen and suction. There is a stop-clock and a graduated water manometer. The trigger type aspirator is oxygen activated.

Iselin (1964) from Copenhagen described a simple respiration table having an oxygen supply with a mechanical safety valve preventing manual ventilation with a rebreathing bag. Suction and a stop-clock were provided. Lurie (1963) he gave, an account of a modified trolley which incorporated a thermostat cooling bath together with a basket for placental transfusion. Although he stressed the importance of speed in active resuscitation, he placed perhaps undue emphasis on the deliberate cooling of the asphyxiated neonate.

Levy (1964) described a respiration unit made at the Central Middlesex Hospital, London. This apparatus had an aneroid manometer as a control for positive pressure ventilation.

Allen (1962) gives a description of a simple respiration unit and explained the need for basic equipment to be readily to hand.

Pryor (1962) gave details of his modifications of Barker's trolley. This had a water manometer but oxygen and suction was not incorporated.

Kobayashi (1966) described a timing respiration trolley with a aneroid oxygen delivery apparatus which included a safety valve. Section was provided on the control panel.

Every casualty and requires some form of respiration trolley but need expensive standard equipment is available. It seems that he had to individually constructed machines. A further modification trolley of improved design which has been in routine use for two years is therefore described.



FIGURE 1



FIGURE 2

Description

The trolley consists of a self-contained mobile unit providing variable oxygen administration and suction. There is provision for warming the baby and the respiration unit may be used as a temporary incubator.

On the lower shelf there are two horizontally mounted high-capacity oxygen cylinders with standard gauges and reducing valves. On one side there is an 18 foot warming lead for connection to a 230 volt electricity supply.

On the middle shelf there are drawers for instruments. Two 5 amp electric sockets and a main indicator lamp are fitted. There is an electric water pump (Aesmont, Yverdon) and a handfilter unit. The latter may be connected in line with the direct oxygen supply to the vat.

The upper shelf is of stainless steel 95 cm from the ground and has a 45 degree gash release sliding device. It carries the heavy gauge glass pressure receptors for which maximum 40 x 30 cm. There is a deep bowl to facilitate collection and a detachable sliding canopy 25 cm in height or fixed. The vat has a perforated brass basket in which a hot water bottle or electric heating pad may be inserted. A foam rubber mattress is used over the base plate which can be removed for cleaning.

Two oxygen cylinders are mounted on the right side of the vat. There is a direct supply for use with nasal cannulae, bag, funnel or catheter. There is also an indirect supply which includes a finger valve for positive pressure ventilation with connection to an endotracheal tube.

Two oxygen ports are mounted on the left side of the vat giving a choice of constant or variable oxygen pressures.

Instruments and controls are located to the rear of the vat. These consist of an oxygen flowmeter graduated to 10 litres per minute, an air-oxygen manometer calibrated to 45 cm. water, a carbon pressure gauge reading up to 30 cm. mercury and a regulator switch to select the type of oxygen supply.

With the regulator switch set on "direct supply" oxygen is obtained under flow meter control. When the regulator switch is set to indirect supply oxygen is automatically drawn through the air-oxygen manometer and is available under finger valve control.

The manometer itself is designed for safe positive pressure oxygen administration and has an audible oxygen valve set at 20 cm. water. Audible resistance is normally turned out with direct observation of the large manometer dial for the audible blow-off and safety valve release added security.

A snap-check is provided. Humidity and temperature gauges are fitted inside the vat which may be manually heated to maintain neonatal hyperthermia. The vat may also be used as a temporary incubator by the addition of the canopy and connection to the handfilter unit. The air temperature may be raised from 64°F to 84°F in 45 minutes using a 6 litre hot hot water bottle. Alternatively the electric pad (Tremco, Switzerland) will raise the air heat to 90°F and maintain it at the required level by means of a thermostat switch.

Discussion

Since 1964 great care has been taken to ensure success of the equipment needed for the resuscitation of the newborn and described in detail the clinical methods which should be employed. Particular emphasis was placed on the value of positive pressure ventilation using a water manometer but the preferred measurement method as being costly and usually overlooking it.

The advantages of the policy described in this account are that it is inexpensive

and easily corrected. It is a fairly simple device, is almost silent, causes no pain, and is well tolerated and tolerated with almost cheerfulness.

It offers a safe and useful method of passive pressure ventilation and positive support to be given by any other method. There is a fall-back infant respiration not so opposed to a simple tube and nasal ventilation and intubation may be carried out single-handed. The infant may be returned to constant hypobaric constant intubation if not required and the set may be immediately converted into a modified incubator.

Summary

An inexpensive but adaptable apparatus set is described and compared with existing equipment. The necessity for some and early separation of the anoxic neonate is stressed and the important design of hypobaric set indicated. The routine provision of suitable apparatus of this kind in all maternity units is advocated.

ACKNOWLEDGEMENTS

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I am also indebted to the Medical Director General for permission to publish this article.

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Manufacturer's Information

"The Infants Infant Anoxaemias Unit" Price £175.

Medical Dept. Division of Respiratory Unit

at New Childrens House, London W1

The "Anoxaemias Unit" at Royal Hotel de Suisse Price £110

Medical Department Ltd

c/o Duke Street, Wigmore Street

London W1

A MODIFIED 'NOVOX' RESUSCITATION APPARATUS

By Surgeon Commander A. O'Connor, R.N.

The 'Novox' resuscitator has been in use on the Royal Navy for thirty years and has proved itself in this time to be a sturdy piece of apparatus. It has also been adopted by Industry by Messrs. Baxandall (Lancaster) and Royal Ordnance (Farnham). Reports of several accidents in which it has saved life appear in the *list for Robert Drury Book: Breathing an Incompressible Atmosphere*. In an original form it consisted of a fifteen cubic foot cylinder of Decather gas, 10% per cent oxygen and 7 per cent carbon dioxide connected to a breathing bag equipped with a long-operated gas admission mechanism, a double breathing tube and a mask. The only modification, which was introduced into the Royal Navy about thirty years ago, was to replace the Decather gas with pure oxygen.

This method of delivering oxygen to a patient through a long-operated mechanism had the merit of economy, but respiratory effort had to be present or induced by artificial respiration, before any oxygen could enter the lungs. In addition, the mask had to be very closely applied to the face, so any leak at this point would tend to prevent the valve mechanism in the bag operating efficiently. This lack of proof fitting of a mask, is not always easy to obtain, particularly if the patient is having artificial respiration at the same time.

With the widespread use of anaesthetics, positive pressure respiration in anaesthetics and thoracotomy, and the reduction of the value of inflated air resuscitators, it is generally agreed that a modern resuscitator must have some means whereby the operator can readily inflate the lungs of an unconscious patient who is not breathing. After discussing this point at a meeting of anaesthetic specialists in the Medical Department in 1962, it was decided to set up a small committee to investigate the possibility of equipping the Royal Navy with such an instrument. Both anaesthetists and physiologists were represented on the committee and Dr. C. S. W. Ogden, Consultant in Anaesthetics to the Royal Navy, very kindly consented to act as an advisory group.

It was felt that the ideal apparatus would have the following features:

- (1) It should be simple and portable but very robust. For this reason the compressor tended to favour manual operation rather than automatic cycling.
- (2) The operator must be able to inflate the lungs of an apnoeic patient with a high percentage of oxygen.
- (3) It must enable a spontaneously breathing patient to receive oxygen with as little resistance as possible.
- (4) It would be an advantage if the operator could null out the apparatus to deliver atmospheric air into the lungs should the oxygen supply run out.
- (5) As few adjustments of the controls as possible should be necessary whilst the machine was in use.

There was _____ type of transmitter on the mask which easily fulfilled all these requirements. The main types fell into two groups:

- (a) Those worked by the pressure of gas in an oxygen cylinder. These either opened automatically or required oxygen when the operator pressed a button. Though efficient, the former was complicated in design and most were useless when the cylinder became exhausted.
- (b) Those types operated by squeezing a bag. These were simple and efficient but not easily capable of dealing with spontaneous respiration if the bag was strong and not fitting and useless when the cylinder was exhausted if the ordinary rebreathing type of bag was used.

To help in coming to a decision, a series of experiments was held to determine how easily a person's lungs could be inflated by operators of varying degrees of experience, including those with no experience at all—using a variety of respirators. For most of these experiments a Clonidine Wilson teaching aid was used or a mouthpiece. It was found not unexpectedly that experienced operators got good results from any type of apparatus mainly because they were adept at holding on to face mask. The less skilled the operator, the more he preferred to use the automatic or push-button type of machine—but at the same time it was obvious to those running the experiments that he was in fact getting more efficient results from squeezing a bag or bellows. This method tended to give him more positive control and enabled him easily to overcome the inevitable leakage round an imperfectly applied mask.

There was left to be an important point and as a result of these tests it was decided to use a hand operated machine and to use a bellows instead of a bag. This change was made because a bellows always allows spontaneous respiration and a man can breathe during expiration more readily than a collapsible bag. It can also be easily operated, ease of change due to prolonged stoppage needs adverse climatic conditions and has a slight advantage in that its use is immediately obvious to the most experienced person who might see the apparatus.

Using a bellows meant that a non-rebreathing type of valve had to be included by the face mask and a valve of the Rotator type was chosen as being both readily available and reliable, although other types of valve may be used in the future. The mask chosen was an MTE. Even ready type, with a thin rubber flange round the face piece, as this was found to be the one that attracted least need to the face itself.

The great problem was to find a simple method of producing a flow of oxygen which would:

- (a) give 100 per cent oxygen in the mask
- (b) enable the user to reduce the pressure, after a time to economise on gas
- (c) allow artificial respiration to continue with air when the cylinder was empty or being changed, without pause or adjustment in the contents

will allow spontaneous) temperature with oxygen & (4) also, again without any adjustment.

This problem was solved by means of oxygen escape-or, in, a device in that case being the compressed spring leading to the bellows which was made about three feet long and open to the atmosphere at the other end. Oxygen is fed into this open ended tube from which the bellows draws its supply. When the gas cylinder is nearly empty the percentage of oxygen pumped from the bellows will inevitably drop as more air is sucked in as a diluent and only air is being delivered. At this point the cylinder can be changed but as no time need there be any interruption or adjustment in the contacts, nor in the rate or rhythm of pumping, particularly critical. It was found that a flow rate of fourteen litres a minute, produced 45 per cent—the actual figures depending slightly on the method of pumping. This range of flow rates was practically chosen as the most suitable.

At this point the design was generally agreed upon and the question arose as to whether to produce a new machine altogether or not so much as possible of the original Novas. The latter plan had the advantage of being cheaper and of retaining the familiar name and appearance so the Langworthy Scientific Company had very kindly built a prototype of a Novas box which was sent to Sirie Coleman Ltd for their remarks. They were very interested in the project and produced the final model which having been passed by the British Council in Amsterdam was shown at the latest meeting of scientific specialists in 1964 and approved by all those present.



Figure 1. Novas 15 (Langworthy Scientific).

Figure 1 shows the Novas 15 in an initial form and Figure 2 shows a later method of construction. Just as the original Novas unit and cylinder are retained but so too as the oxygen a larger control is provided of electronic shape and colour so that it can be instantly identified and turned with one hand. Immediately the oxygen is turned on it starts to flow into the tubing, reservoir, atmosphere, of the leading of the second control valve which simply turns the flow on between four and fourteen litres a minute. This flow control cannot be turned off altogether.

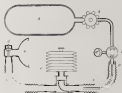


Figure 2. B. and A. Respiration Apparatus.

is used, which was deliberately introduced so that it would never be necessary to switch two controls before the machine could be used. The bellows can be operated the moment the valve is opened and the work applied to the patient's face when it will deliver air until the oxygen is switched on. In order to avoid any delay it is recommended in the instructions that this should be done so that the patient's lungs are already being inflated while the oxygen is being turned on and the flow control set to high. The bellows itself is equipped with magnets on the base so that it snaps firmly on a metal plate secured to the back of the case and can easily be operated with one hand. Alternatively it can be tilted out and will clamp itself to a metal desk or table being supplied with about six feet of corrugated tubing for the purpose. Incidentally all possible complications are of course avoided distribution in undesirable climates.

After a few minutes of positive pressure artificial respiration at the maximum oxygen percentage the flow rate can usually be reduced without decrease in the patient, while effecting a considerable economy in the use of oxygen. At the low rate of flow a full cylinder should last for nearly two hours.

Once the patient starts to breathe by himself the operator can limit his efforts to coincide with those of the patient and as soon as there are judged to be adequate he simply stops pumping—no adjustment is necessary for spontaneous respiration which takes place at a low resistance (about 30 mmHg). Should the cylinder become exhausted at any time during artificial respiration the bellows will continue to deliver air whilst the cylinder is being changed—again without any interruption or adjustment. It has from the moment the work is applied and the oxygen switched on no further adjustment need be taken by the operator or worker whilst function the machine may have to perform. This is considered an important feature

of the apparatus and hence the operators need not leave directly from the console when the radar is

The first Narvik war ship, now being modified by Sigsbee Electronic Ltd who will be carrying out these alterations as its business due for servicing. In this way it has been possible both to reduce the cost of the modifications, and to ensure that ships and establishments are not left without an apparatus for consultation for any period.

ACKNOWLEDGEMENTS

The assistance is extremely grateful to the Longworth Scientific Instruments Company, Ltd. who, including help and advice at all stages of their development and who by Mr. John H. Jones (formerly for long time with the Royal Navy) who was attached to the U. S. Navy (United States) in connection to the Royal Navy for his valuable advice and assistance which has helped to produce a machine that will fulfil all our requirements at a price which will make it readily available.

MINOR PSYCHIATRIC MORBIDITY AMONG ROYAL NAVAL APPRENTICES

By Surgeon Lieutenant Commander C. B. Kell, RNR

Information regarding the frequency and consequences of minor mental ill-health among young people is accumulating at many training centres, universities and from postal practice studies. Two views tend to undermine the validity of minor population comparisons of the prevalence of psychiatric morbidity. The first is fundamental and basic to all enquiry in psychiatric epidemiology: much of the difficulty in arriving at true morbidity estimates is due to the fact that by no means all who have these conditions register their distress by seeking medical aid. Second difficulties in comparative studies arise from lack of uniformity in criteria for illness. Morbidity rates based on mentions of patients who have clearly defined psychiatric disorders generally give an under-estimate of the extent of severe illness among patients and rarely include those who consult with minor psychological complaints. On the other hand rates based on less rigid criteria provide much higher estimates, but less validity in aetiological interpretation.

This paper reports an enquiry into the prevalence of medically detected psychiatric morbidity among a series of new entrants to apprentice training in a naval training establishment. This enquiry was deliberately conceived so that various case finding techniques and criteria for illness could be employed for the detection of psychiatric morbidity among the apprentices as had been used identically in similar morbidity studies among young people attending general practitioners (Kell, 1966) and new entry students (Kell and Childs-Miles, 1969). The purpose of this study was, by using the same methods, to compare the prevalence of minor psychiatric disturbance among the Royal Naval apprentices with the similar findings among young men in the general population and among university students.

METHOD

At the beginning of a chosen survey year a total group of apprentices who comprised the new entry recruit consecutive intake to a naval training establishment, were identified. Each completed a questionnaire which provided their social and demographic characteristics. As well as this each completed a questionnaire-type psychological test the Marlowe Personality Inventory (Epstein, 1957).

At the end of the survey year case identification was carried out. The objective in this instance was not to identify apprentices who were in need of specialized psychiatric care, but to identify and count those who were found by the medical officers to have manifested evidence of a psychological disorder during the survey year. The working definition of illness adopted was that proposed by Eckert, Shaw and Evans (1955) namely: a disturbance of a patient's health that is reflected in at least one constellation. All details of medical observations for illness made by the apprentices during the survey year were maintained in consultation with the medical officers. The purpose was to determine within a framework of defined

criteria whether or not an applicant had (previously) a consultation for a psychological condition during this time.

The criteria used to identify the likelihood of a psychological condition in the patient's consultation was based on that described by Green (1980) which had already been found useful in morbidity studies among young people. This technique employs a classification of illness derived from the codes of presenting psychiatric disorder and was designed for use by the general medical practitioner in their office.

By this method the one year period prevalence rate for major psychiatric morbidity among the cohort of apprentices was determined.

The number of consultations for illness made by each apprentice was also counted and recorded.

FINDINGS

Characteristics of the apprentices

The apprentices, 119 in number, were an average cross-section of the young people who normally make up the training strength of the establishment. Of the 119 apprentices 101 were single and 18 were married. Fifty-nine were aged 15 years or less on entry to training, 56 were aged 16 to 20 years, and 4 were aged 21 or more prior to entry.

Most (87) apprentices were English, 8 were Scottish, 11 came from New Zealand, 1 from Ghana and one from Canada.

The socio-economic background of each was determined by referring to the Registrar General's Classification in respect of the occupation of the supporting parent. Of the 119 apprentices 11 came from social class I, 14 from II, six from III, 21 from IV and 16 from V. The occupational status of the parents of these apprentices was not known.

Thirty-two apprentices had had prior experience of living away from home before joining the Navy. 78 had not. Seafarer apprentices came from broken homes, and 10 stated that their home background was unhappy.

Personality profile

The Maudsley Personality Inventory (MPI) is a psychological questionnaire instrument which has been standardized independently and for which normative data are available. Scores are laid down in two directions — Extroversion/Introversion and Neuroticism. Extroversion is antithesis to Introversion refers to the outgoing/unilateral social preference of a person. Neuroticism is defined as the general emotional lability of a person, his emotional responsiveness and his liability to neurotic breakdown under stress.

The mean score on Extroversion/Introversion for English males in the same age group as the apprentices is $M=11$ (standard deviation 8.77). The mean for the apprentices was 26.77 (standard deviation 8.17).

The mean Neuroticism score for English males in the same age group as the apprentices is 19.89 (standard deviation 11.61). The mean for the apprentices was 27.77 (standard deviation 8.43).

By comparing the apprentices' scores with the norms it was found that the

Examination/Interviews in the diagnosis, as shown against 2.00 (standard error) 0.53 ($P=0.001$) and for Maudsley the difference in mean equals 2.17 (standard error 0.54 ($P=0.01$)). This indicates that the apprentices of this group were significantly more concerned and had significantly higher scores for Neuroticism (a more prone to anxiety) than young hospitalists of the same age group in the general population. Social class differences did not affect the significance of these results.

Consultation rates

The consultation rate is the number of times a consultation is made for illness by a patient over a stated period of time. These rates were intended to provide an auxiliary index of mental health status. While patients with high consultation rates are not necessarily ill, most patients do on average have high consultation rates. This has been demonstrated for general practice patients (Kessel 1960; Shepherd, Fisher, Davis and Kessel 1959) and for university students (Kessel 1960).

During the period of writing only 16 apprentices had not made any consultations for illness. Twenty-two had made one consultation, 21 had made two, 23 had made three, 12 had made four and 23 had made 5 or more. Assuming a consultation rate of 5 per year is high for healthy young people, approximately one quarter of the apprentices had high consultation rates.

The prevalence of minor psychiatric disorders

Of the 114 apprentices during the period of writing 10 (9% per cent) had made at least one consultation for an illness which was diagnosed by the standard medical officers to have been for a psychological condition in the terms of Kessel's criteria.

Of these two were diagnosed to be cases of anxiety neurosis, one of relative depression, one of hysterical behaviour, one of minor anxiety features, three of personality disorder (maturity and emotional immaturity) and two cases of this feature in which emotional factors were considered by the doctors to be both inconspicuously present and contributory to distress.

Comparison of prevalence rates for psychiatric morbidity

The Table indicates the prevalence of psychiatric disorders among the Royal Naval apprentices and other groups of young people amongst whom the same case finding techniques and criteria have been used.

| Group | Expected No. | Psychiatric Disorders Males | % |
|-------------------------------------------|----------------------------|-----------------------------------|------|
| ROYAL NAVAL APPRENTICES | Psychiatric investigation | 10 | 9.0 |
| UNIVERSITY STUDENTS | Kessel C. B. (1960) | 61 | 54.0 |
| SEAFARERS | Colclough-Morris J. (1964) | 246 | 48.0 |
| GENERAL POPULATION (age specific data) | Kessel W. H. (1960) | 117 | 9.0 |

Despite the social and demographic dissimilarity of the four groups shown in the Table, the prevalence of psychiatric disorders among all these groups of young men is identical. The Royal Naval apprentices in this series were no more so

LETTER TO THE EDITOR

Sir,

Extension of selected tuberculous patients in the Royal Navy

At the Symposium on Naval Medicine, the issue for discussion of Surgeon Commander Under's paper did not permit consideration of my question concerning the disposal of newly joined ratings who react strongly to blindness testing. Those with whom I discussed the problem usually the morning were inclined to the view that the way to handle young recruits given such a reaction was to retain them in the Service and keep them under observation, which is consistent with the practice Surgeon Commander Under advocates in his paper (which as far as I recollect was not mentioned at the Symposium). At the time I was under the impression that those who reacted strongly to tuberculin had a much greater chance of becoming open cases of pulmonary tuberculosis than young men who did not react or who had only a mild reaction, and I wondered whether on view of the environmental conditions under which Naval personnel live, that was a risk the Ministry should accept. After the meeting I wrote to Doctor T. M. Forth, who was Secretary of the Medical Research Council's Tuberculosis Veterans Council Study Committee, with whom I have discussed this problem over the years. The relevant paragraphs from his reply dated 1st September, 1960, which I have his permission to publish are as follows:

The evidence that individuals with large reactions are more likely to develop tuberculosis than those without is chiefly based on the MRC Test of BCG which was made in individuals who were aged 14 years or under. The greatest annual incidence in this susceptible group was 3.5 per 1000 as opposed to 1.66 per 1000 in the unvaccinated control group and 0.77 per 1000 in those with small reactions. The relatively high annual rate of 3.5 per 1000 in those with large reactions persisted only for the first 14 years of observation. Thereafter it declined very considerably and from 15-5 years was 1.67 per 1000. There was a further substantial decline in the period 5-11 years of observation. There is no provision for the findings in individuals which covered the period from approximately 1951-9 would necessarily be the same among recruits to the Navy who would presumably be under older an entry and would also be living in a different environment. Thus, the reactions are that although the recruits with large reactions are more likely to be more susceptible than those with small reactions, the risk is certainly not anything like 1 in 20.

While I had that it is worth keeping recruits with large reactions under X-ray surveillance I should not have thought it necessary to exclude them from the Navy. The success of the risk to individuals with low degrees

of sensitivity appears in the second report to the MRC by the Tuberculosis Vaccines Clinical Trials Committee (1954-1963) in pp 174-186.¹

This most helpful letter clarified the issue for me, and I hope it may be of help others who have doubts concerning the current procedure.

I am, Sir

Yours obedient servant,

(signed) F. P. Ellis

Surgeon-Captain, Royal Navy

The reviewer doubts the wisdom of the words by which, according to the author, the great masses in a revolution are being conditioned by the propaganda of the bourgeoisie and the bourgeoisie are conditioned by the propaganda of the bourgeoisie. The author, however, does not seem to have any other idea of the propaganda of the bourgeoisie than the propaganda of the bourgeoisie. The author, however, does not seem to have any other idea of the propaganda of the bourgeoisie than the propaganda of the bourgeoisie.

In the reviewer's opinion the book does not offer the reader any new ideas, but only a very superficial and superficial view of the subject.

There is a very large amount of material in the book, but it is not very well organized. The author, however, does not seem to have any other idea of the propaganda of the bourgeoisie than the propaganda of the bourgeoisie. The author, however, does not seem to have any other idea of the propaganda of the bourgeoisie than the propaganda of the bourgeoisie.

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—(1991) *Journal of the Philosophy of Education Society of Great Britain* 20, 1, 1–12.

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There is a growing body of research that suggests that the use of technology in the classroom can have a positive impact on student learning. This research is based on the idea that technology can provide students with access to a wide range of resources, including interactive learning materials, online courses, and virtual reality experiences. By using technology, students can learn at their own pace and in a way that is most effective for them. This can lead to improved learning outcomes and a more engaging learning experience.

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[illegible]

Inventory, or Register, or List. Vol. 1. Second Printing. Pp. 171. 12s. 6d. (London: Longmans, Green, 1911.)

Without the complete destruction of the enemy's air power, it is hardly possible that any of the strategic problems of Europe would be appreciably simplified. It is therefore best not to mechanically follow an existing specific formula, and to adapt the situation.

The first volume needed beyond finding the roots is an (80 pages or so) highlight version of *From Below*, as this is also nearly essential reading.

¹ In 1968, essentially the same paper was read at the Proceedings of the Twenty-Ninth Symposium on the Biology of the Insect, held at the University of Illinois, Urbana, Illinois, 1-5 June 1968. I propose to stress, underlining the history of this breeding, trials in insect anatomy, special reference to measurements of mandibles, calyces, teeth.

An interesting review is published of the Spanish fly-leopard, which is well illustrated with a generous number of good quality photos. This is backed up by a rather more fully informed appraisal of the evidence concerning the existence of Devil cells in leopards in North America, and Africa.

Experiments of random shuffles and those just performed appear to agree satisfactorily with those that have already been carried off the other systems. A repeated analysis of the data in the present and in separate papers.

In summary, this volume is most suitable and provides no modified view of relevance for those who wish to learn more about the interesting and in fact, the often neglected subject.

For more information, contact: Dr. M. Marjorie Hill, Dept. of Education and W. Lawrence Taylor, MEd. EdM.,
Box 100, 1001 University Boulevard, Seattle, WA 98101-1000, Phone 206/543-1144

Despite the recent change of her index, the probability that she engaged in any religious activities, whether alone or with others, is lower in the case of the female respondents than in the case of the male respondents.

There were two fundamental characteristics of the cultural values of society, and further, there was a significant source of all the mentioned difficulties, according to the study. In terms of the society, the first of them was a change and modernization (modernization), which is a general phenomenon in capitalist countries, especially in the Soviet Union. These modernizations, including World Values Research and Moral Development in Marriage (The Age and Level of Marriage), and modernization by means of population movements and other, economic, social, and cultural, such as mass media, become, in the modernization process, a source of the mentioned difficulties. The second characteristic of the society was a change and modernization, which was a source of all the mentioned difficulties, according to the study.

[illegible]

Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2

1. *What is the purpose of the study?*
 2. *What are the research objectives?*
 3. *What is the research methodology?*
 4. *What are the results of the study?*
 5. *What are the conclusions of the study?*
 6. *What are the implications of the study?*
 7. *What are the limitations of the study?*
 8. *What are the future research directions?*
 9. *What are the contributions of the study?*
 10. *What are the key findings of the study?*

The authors gratefully acknowledge the financial support of the National Natural Science Foundation of China (Grant No. 81073069) and the Shanghai Leading Academic Local Project (Grant No. Y1101).

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| Presented by Appointment M.D. Ph.D. in 1979 | 1981-82, Miami University of Oxford, Oxford, Ohio, U.S.A. | 1983-84, University of Oxford, Oxford, U.S.A. |
|------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------|

The book is written in an easy-to-read style, and is suitable for use by students and teachers alike. It is a valuable addition to the literature on the history of the United States, and is highly recommended.

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4. *Methods in Pharmacology*, 7th ed. [a series: *Methods in Pharmacology*, 1-265]. Edited by S. Spector. Philadelphia: Lippincott and Company, H. K. Lewis, Ltd. Price £45.00. Pp. xiv + 265.

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Obit of Dr. Hargrave

CONTINUED

Dr. Hargrave was born in 1890 at New York City, New York. He was educated at the University of California, Berkeley, and at the University of Michigan, Ann Arbor. He was a member of the American Medical Association and the American Society of Tropical Medicine. He was a member of the American Society of Tropical Medicine and the American Society of Tropical Medicine and Hygiene. He was a member of the American Society of Tropical Medicine and Hygiene. He was a member of the American Society of Tropical Medicine and Hygiene.

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Dr. Hargrave, a member of the American Medical Association.

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